





ADULTERATIONS

OF

H. S. Harris.

VARIOUS SUBSTANCES

USED IN

MEDICINE AND THE ARTS,

WITH THE MEANS OF DETECTING THEM:

INTENDED AS A MANUAL FOR THE PHYSICIAN, THE
APOTHECARY, AND THE ARTISAN.

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PREFACE.

THE design of this work is to exhibit the adulterations of various substances, being principally such as are used in Medicine and the Arts, and to describe the processes by which they may be detected. The authorities upon which I have chiefly depended are, a Manual published several years since under the title of the Domestic Chemist; a treatise *Des Falsifications des Substances Alimentaires*, &c. par J. Garnier et C. Harel; the United States Dispensatory, by Professors Wood and Bache; Pereira's *Materia Medica*; Neligan's *Medicines, their Uses*, &c.; Ure's *Dictionary of Arts*, &c.; Parnell's *Applied Chemistry*; H. Rose's *Manual of Analytical Chemistry*, and Fresenius on *Qualitative Chemical Analysis*. Various scientific periodicals have also been consulted; but these it is unnecessary to enumerate, as due credit is given for every important fact which has been obtained from them.

The processes for the detection of the adulterations noticed in this volume, are usually quite simple, and may be easily followed even by the tyro in chemistry. In a few cases, however, they are more difficult, and some knowledge of the details of the science and some experience in the business of testing will be necessary. I have endeavoured especially to render the descriptions of such processes as plain and as free from technicalities as possible.

It should be distinctly stated, that directions for the accurate quantitative analysis of the substances here described do not fall within the scope of this work. All that is proposed to be determined is the nature of their adulterations, and in some cases an approximation to the proportions in which these exist. As a means towards the accomplishment of the object in view, I have also given the characteristics of most of the bodies in their state of entire purity.

Besides the names employed as the basis of the alphabetical arrangement which has been adopted, others have been added as synonyms. Thus of the medicinal articles, the names used in the Pharmacopœia of the United States (indicated by the letters U. S.) have in all cases been given. To obviate the difficulty which might otherwise arise on this account, a very copious index has been prepared. It is believed that no one who may use this volume as a book of reference will consider this an unnecessary addition.

In the appendix will be found full descriptions of the various chemical operations noticed in the body of the work, directions for the preparation of reagents, and several tables exhibiting the behaviour of some reagents with the more important substances. The materials for the first two divisions have been chiefly drawn from the work of Fresenius already referred to; while the tables have been compiled from Will's Outlines of Qualitative Analysis.

If it is deemed important to guard against the bodily injury and pecuniary loss which must often arise from the employment of adulterated substances, the utility of a work of this kind will be readily admitted. Whether the author has been successful in his attempt to prepare such a manual as seems to be required, is now submitted to the decision of those for whom it is especially intended.

Rutgers College, N. J., September, 1846.

CONTENTS.

| | |
|---|--|
| <p>Acetic Acid, . . . 13</p> <p>Aconitine, . . . 18</p> <p>Alcohol, . . . 19</p> <p>Aloes, . . . 23</p> <p>Alum, . . . 24</p> <p>Amber, . . . 25</p> <p>Ammonia, . . . 25</p> <p style="padding-left: 20px;">Acetate of, . . . 26</p> <p style="padding-left: 20px;">Muriate of, . . . 26</p> <p style="padding-left: 20px;">Nitrate of, . . . 27</p> <p style="padding-left: 20px;">Sesquicarbonate of, 27</p> <p style="padding-left: 20px;">Spirit of, . . . 28</p> <p>Ammoniac, . . . 28</p> <p>Animé, . . . 29</p> <p>Aniseed, . . . 30</p> <p>Annotto, . . . 30</p> <p>Antimony, . . . 31</p> <p style="padding-left: 20px;">Oxysulphuret of, 32</p> <p style="padding-left: 20px;">Sesquioxide of, 34</p> <p style="padding-left: 20px;">Sesquisulphuret of, 35</p> <p>Antimony and Potassa,</p> <p style="padding-left: 20px;">Tartrate of, . . . 35</p> <p>Antimonial Wine, . . . 37</p> <p>Arrow-root, . . . 37</p> <p>Arsenic, . . . 38</p> <p style="padding-left: 20px;">Yellow sulphuret of, 39</p> <p>Arsenious Acid, . . . 39</p> <p>Assafœtida, . . . 40</p> | <p>Atropine, . . . 41</p> <p>Balsam of Copaiba, . . . 41</p> <p>Balsam of Peru, . . . 43</p> <p>Balsam of Tolu, . . . 43</p> <p>Barium, Chloride of, . . . 44</p> <p style="padding-left: 20px;">Nitrate of, . . . 44</p> <p>Beer, . . . 45</p> <p>Benzoic Acid, . . . 46</p> <p>Benzoin, . . . 47</p> <p>Bismuth, . . . 48</p> <p style="padding-left: 20px;">Subnitrate of, . . . 49</p> <p>Bleaching Powder, . . . 50</p> <p>Boracic Acid, . . . 51</p> <p>Bromine, . . . 52</p> <p>Burgundy Pitch, . . . 52</p> <p>Cacao and Chocolate, . . . 53</p> <p>Cajeput Oil, . . . 55</p> <p>Calcium, Chloride of, . . . 55</p> <p>Camphor, . . . 56</p> <p>Canella Alba, . . . 56</p> <p>Canna Starch, . . . 57</p> <p>Cantharides, . . . 57</p> <p>Caraway Seeds, . . . 58</p> <p>Cardamon Seeds, . . . 58</p> <p>Carmine, . . . 59</p> <p>Castor, . . . 60</p> <p>Castor Oil, . . . 60</p> <p>Catechu, . . . 61</p> |
|---|--|

| | | | |
|-----------------------------|----|--|-----|
| Cayenne Pepper, | 62 | Gum Arabic, | 93 |
| Charcoal, | 62 | Gunpowder, | 94 |
| Animal, | 63 | Hog's Lard, | 94 |
| Cider, | 64 | Honey, | 95 |
| Cinnamon, | 65 | Hops, | 96 |
| Citric Acid, | 66 | Hydrocyanic Acid, | 96 |
| Cloves, | 68 | Hyoscyamine, | 98 |
| Coal Gas, | 68 | Indigo, | 98 |
| Cobalt, | 69 | Iodine, | 99 |
| Oxide of, | 69 | Tincture of, | 100 |
| Cocculus Indicus, | 69 | Ipecacuanha, | 100 |
| Cochineal, | 70 | Iron, | 101 |
| Coffee, | 71 | Black Oxide of, | 102 |
| Colchicum, | 73 | Carbonate of, | 102 |
| Colocynth, | 74 | Lactate of, | 103 |
| Colcothar, | 74 | Perchloride of, | 103 |
| Colomba Root, | 75 | Protiodide of, | 104 |
| Common Salt, | 76 | Sulphate of, | 104 |
| Confectionary, | 78 | Red Oxide of, | 105 |
| Conium, | 80 | Iron and Potassa, Tartrate of, | 107 |
| Copper, | 81 | Jalap, | 107 |
| Acetate of, | 81 | Kino, | 108 |
| Ammoniacal sulphate | | Lampblack, | 109 |
| of, | 82 | Lead, | 109 |
| Diacetate of, | 82 | Acetate of, | 110 |
| Sulphate of, | 83 | Carbonate of, | 111 |
| Creasote, | 83 | Chromate of, | 112 |
| Croton Oil, | 84 | Iodide of, | 113 |
| Cubebs, | 85 | Protoxide of, | 114 |
| Dragon's Blood, | 86 | Red Oxide of, | 114 |
| Ergot, | 86 | Lime, | 115 |
| Gall-Nuts, | 87 | Carbonate of, | 117 |
| Gamboge, | 88 | Liquorice, | 118 |
| Gentian, | 89 | Logwood, | 119 |
| Gold, | 89 | Lycopodium, | 119 |
| Chloride of, | 91 | Madder, | 120 |
| Iodide of, | 91 | Magnesia, Calcined, | 121 |
| Graphite, | 91 | Carbonate of, | 122 |
| Guaiac, | 92 | Sulphate of, | 124 |

| | | | |
|--|-----|------------------------------------|-----|
| Manganese, Peroxide of, | 126 | Phosphorus, | 163 |
| Manna, | 128 | Platinum, | 164 |
| Mercury, | 129 | Pomegranate Bark, | 165 |
| Bicyanide of, | 130 | Potassa, Acetate of, | 165 |
| Black Sulphuret of, | 130 | Bicarbonate of, | 166 |
| Perchloride of, | 131 | Binoxalate of, | 166 |
| Periodide of, | 131 | Bitartrate of, | 167 |
| Peroxide of, | 132 | Carbonate of, | 168 |
| Protochloride of, | 133 | Chlorate of, | 171 |
| Protoxide of, | 135 | Chromate of, | 172 |
| Red Sulphuret of, | 136 | Nitrate of, | 172 |
| White Precipitate | | Sulphate of, | 175 |
| of, | 137 | Tartrate of, | 175 |
| Milk, | 138 | Potassa and Soda, Tartrate | |
| Morphine, | 141 | of, | 176 |
| Acetate of, | 141 | Potassium, Bromide of, | 177 |
| Muriate of, | 142 | Chloride of, | 177 |
| Sulphate of, | 142 | Cyanide of, | 178 |
| Muriatic Acid, | 143 | Ferrocyanide of, | 179 |
| Mushrooms, | 144 | Iodide of, | 180 |
| Musk, | 145 | Protoxide of, | 182 |
| Mustard, | 146 | Prussian Blue, | 183 |
| Myrrh, | 147 | Purple of Cassius, | 184 |
| Naphtha, | 148 | Quassia, | 185 |
| Nitric Acid, | 148 | Quinine or Quinia, | 185 |
| Nitrogen, Protoxide of, | 149 | Disulphate of, | 185 |
| Nitromuriatic Acid, | 150 | Red Saunders, | 188 |
| Nitrous or Hyponitrous | | Rhubarb, | 189 |
| Ether, | 150 | Roses, Otto or Attar of, | 192 |
| Nutmeg and Mace, | 152 | Safflower, | 192 |
| Oils, Essential or Volatile, | 153 | Saffron, | 193 |
| Olive Oil, | 155 | Sago, | 194 |
| Opium, | 157 | Salep, | 195 |
| Oxalic Acid, | 158 | Salicin, | 196 |
| Palm Oil, | 159 | Sarsaparilla, | 196 |
| Pepper, Black, | 159 | Scammony, | 198 |
| Peruvian Bark, | 160 | Scheele's Green, | 199 |
| Phloridzin, | 162 | Schweinfurt Green, | 200 |
| Phosphoric Acid, | 162 | Sealing Wax, | 200 |

| | | | |
|--|-----|----------------------------------|-----|
| Selenium, | 200 | Sulphur, Precipitated, | 233 |
| Senna, | 201 | Iodide of, | 233 |
| Silver, | 203 | Sulphuric Acid, | 233 |
| Chloride of, | 204 | Sulphuric Ether, | 237 |
| Cyanide of, | 205 | Spirit of, | 238 |
| Nitrate of, | 205 | Tallow, | 238 |
| Soap, | 207 | Tamarinds, | 239 |
| Soda, Acetate of, | 210 | Tapioca, | 240 |
| Biborate of, | 211 | Tartaric Acid, | 241 |
| Bicarbonate of, | 212 | Tea, | 242 |
| Carbonate of, (Com- mercial,) | 212 | Thenard's Blue, | 248 |
| Carbonate of, (pure,) | 214 | Tin, | 248 |
| Hypochlorite of, | 215 | Bisulphuret of, | 250 |
| Hyposulphite of, | 215 | Titanic Acid, | 251 |
| Nitrate of, | 216 | Turmeric, | 251 |
| Phosphate of, | 216 | Ultramarine, | 252 |
| Sulphate of, | 217 | Uva-ursi, | 252 |
| Soda Water, | 218 | Venice Turpentine, | 253 |
| Sodium, Iodide of, | 219 | Veratrine, | 253 |
| Protoxide of, | 219 | Water, | 254 |
| Spermaceti, | 219 | Wax, | 255 |
| Starch, | 220 | Wheat Flour, | 256 |
| Storax, | 222 | Wine, | 262 |
| Strontium, Chloride of, | 223 | Zinc, | 266 |
| Strychnine, | 224 | Acetate of, | 267 |
| Succinic Acid, | 225 | Carbonate of, | 268 |
| Sugar, | 226 | Chloride of, | 268 |
| Sulphur, | 231 | Oxide of, | 269 |
| | | Sulphate of, | 270 |

ADDITIONS.

| | | | |
|-------------------------------|-----|----------------------------------|-----|
| Arsenious Acid, | 271 | Opium, | 273 |
| Iodine, | 271 | Potassium, Cyanide of, | 274 |
| Muriatic Acid, | 271 | Iodide of, | 275 |
| Oils, Fat or Fixed, | 272 | Quinoidine, | 275 |

APPENDIX.

I.—OPERATIONS AND INSTRUMENTS EMPLOYED IN QUALITATIVE ANALYSIS.

| | | | |
|--|-----|-------------------------|-----|
| Reduction of Solids to powder, | 279 | Edulcoration, | 284 |
| Solution, | 279 | Evaporation, | 284 |
| Crystallization, | 280 | Distillation, | 285 |
| Precipitation, | 281 | Sublimation, | 285 |
| Filtration, | 283 | Ignition, | 286 |
| Decantation, | 283 | Testing, | 286 |

II.—PREPARATION OF TESTS OR REAGENTS.

| | |
|------------------------|-----|
| Definitions, | 287 |
|------------------------|-----|

A.—REAGENTS IN THE HUMID WAY.

1.—GENERAL REAGENTS.

a. Reagents principally used as SIMPLE SOLVENTS.

| | | | |
|---------------------|-----|-----------------------|-----|
| 1. Water, | 290 | 2. Alcohol, | 291 |
|---------------------|-----|-----------------------|-----|

b. Reagents principally used as CHEMICAL SOLVENTS.

| | | | |
|----------------------------------|-----|----------------------------------|-----|
| 3. Muriatic Acid, | 291 | 6. Acetic Acid, | 293 |
| 4. Nitric Acid, | 292 | 7. Muriate of Ammonia, | 293 |
| 5. Nitromuriatic Acid, | 292 | | |

c. Reagents which serve especially to separate, or otherwise to characterize groups of substances.

| | | | |
|--|-----|-------------------------------------|-----|
| 8. Litmus, | 294 | 15. Carbonate of Potassa, | 298 |
| 9. Turmeric, | 294 | 16. Ammonia, | 299 |
| 10. Sulphuric Acid, | 295 | 17. Carbonate of Ammonia, | 299 |
| 11. Sulphuretted Hydrogen, | 295 | 18. Chloride of Barium, | 300 |
| 12. Hydrosulphuret of Ammonia, | 296 | 19. Nitrate of Baryta, | 301 |
| 13. Sulphuret of Potassium, | 297 | 20. Chloride of Calcium, | 301 |
| 14. Potassa, | 297 | 21. Nitrate of Silver, | 302 |

2.—SPECIAL REAGENTS.

a. Reagents which serve especially for the detection of various BASES.

| | | | |
|--|-----|--------------------------------------|-----|
| 22. Sulphate of Potassa, | 302 | 29. Tartaric Acid, | 305 |
| 23. Phosphate of Soda, | 303 | 30. Bitartrate of Potassa, | 306 |
| 24. Chromate of Potassa, | 303 | 31. Protochloride of Tin, | 306 |
| 25. Ferrocyanide of Potassium, | 304 | 32. Chloride of Gold, | 306 |
| 26. Ferricyanide of Potassium, | 304 | 33. Chloride of Platinum, | 307 |
| 27. Oxalic Acid, | 304 | 34. Zinc, | 308 |
| 28. Oxalate of Ammonia, | 305 | 35. Iron, | 308 |
| | | 36. Copper, | 308 |

b. Reagents which are particularly applied to the detection of various ACIDS.

| | | | |
|--|-----|-----------------------------------|-----|
| 37. Acetate of Potassa, | 308 | 44. Sulphurous Acid, | 311 |
| 38. Caustic Lime, | 309 | 45. Chlorine, | 311 |
| 39. Sulphate of Lime, | 309 | 46. Solution of Indigo, | 311 |
| 40. Protosulphate of Iron, | 309 | 47. Starch Paste, | 312 |
| 41. Acetate of Lead, | 310 | 48. Tincture of Iodine, | 312 |
| 42. Sulphate of Copper, | 310 | | |
| 43. Ammonio-nitrate of Silver, | 310 | | |

B.—REAGENTS IN THE DRY WAY.

| | | | |
|-------------------------------------|-----|-----------------------------------|-----|
| 49. Charcoal, | 312 | 51. Nitrate of Potassa, | 314 |
| 50. Cyanide of Potassium, | 313 | | |

III.—TABLES EXHIBITING THE BEHAVIOUR OF SOME REAGENTS WITH THE MORE IMPORTANT METALS, METALLIC OXIDES AND ACIDS.

| | |
|---|----------|
| TABLE I.—BEHAVIOUR OF SOLUTIONS OF THE METALS WITH SULPHURETTED HYDROGEN AND HYDROSULPHURET OF AMMONIA, | 317, 318 |
|---|----------|

CONTENTS.

XI

| | |
|---|-----|
| TABLE II.—BEHAVIOUR OF THE MORE IMPORTANT ACIDS, ON HEATING THEIR SALTS WITH SULPHURIC ACID, . . . | 319 |
|---|-----|

| | |
|---|-----|
| TABLE III.—BEHAVIOUR OF THE MORE IMPORTANT ACIDS, WITH CHLORIDE OF BARIUM, | 320 |
|---|-----|

| | |
|---|-----|
| TABLE IV.—BEHAVIOUR OF THE MORE IMPORTANT ACIDS, WITH NITRATE OF SILVER, | 321 |
|---|-----|

| | |
|---|-----|
| TABLE V.—BEHAVIOUR OF CERTAIN ACIDS, WITH CHLORIDE OF CALCIUM, | 322 |
|---|-----|

ERRATA.

Page 24, 7th line from top, for "*Cabilline*," read "*Caballine*."

Page 94, 14th line from top, for "*eprovette*," read "*eprouvette*."

Page 98, 1st line from top, for HYOCYAMINE OR HYOCYAMIA," read "HY -
OSCYAMINE OR HYOSCYAMIA."—2d and 9th line from top, for "hyocyamine,"
read "hyoscyamine."

Page 151, 1st line from top, for "*Ætheri*," read "*Ætheris*."

Page 158, 15th line from bottom, for "*Rumea acetosa*," read "*Rumex
acetosa*."

ADULTERATIONS OF ARTICLES

USED IN

MEDICINE AND THE ARTS.

ACACIA.—*See* GUM ARABIC.

ACETIC ACID.

Acidum Aceticum, U. S.

PURE acetic acid has a specific gravity of 1.063, compared with distilled water at 1.000. It has a pungent and very characteristic odour, and a caustic taste ; it dissolves camphor and the essential oils, reddens litmus powerfully, and combines with bases ; it forms blisters on the skin like a mineral acid.

Acetic acid is the basis of the article known under the name of *distilled vinegar*, and of the *vinegar* of commerce in all its varieties.

These several articles are often adulterated with various substances. Acetic acid and distilled vinegar should be perfectly colourless, and should evaporate when heated in a watch glass without leaving any residue. They must, when diluted with water, give no precipitate with chloride of barium, or we may suspect the presence of sulphuric acid. If when neutralized with ammonia and tested with a solution of chloride of barium, they give a white precipitate

which dissolves in dilute muriatic acid, they contain sulphurous acid. If they give a precipitate with a solution of nitrate of silver, they contain muriatic acid. The presence of nitric acid may be suspected if, when a portion of sulphuric acid is added to the suspected liquid, a crystal of protosulphate of iron gives a deep brown tint to the surrounding liquid, and if the solution of indigo is discoloured on being heated with the acid. If when heated with a slight excess of ammonia, a blue solution is produced, it is an evidence of the presence of copper; but if brown-red flocks separate on such addition, the acid holds iron in solution. If liquid sulphuretted hydrogen causes a precipitate, it is due to the presence of a metal.

Six parts of pure acetic acid should saturate about ten parts of pure crystallized bicarbonate of potassa. And by a reference to this standard the proportion of pure acid in distilled and common vinegar may be accurately determined.

There are various kinds of vinegar in commerce, such as *wine vinegar*, *vinegar of wood*, *cider vinegar* and *beer vinegar*. Wine vinegar is prepared by the fermentation of white wine, and is usually colourless. Vinegar of wood is obtained by the distillation of wood, and was formerly an important article of commerce. It is said to be now chiefly used for the purpose of increasing the strength of wine vinegar. Cider vinegar is obtained from the fermentation of the juice of the apple, and is largely used in this country. Beer vinegar is but little used for domestic purposes. Its chief consumption is in the arts.

Vinegar is often adulterated with the stronger acids, as the sulphuric, the muriatic and the nitric; also with some of the vegetable acids, as the tartaric and oxalic acids. Acrid substances are moreover sometimes added to give a factitious pungency to the vinegar, and, through careless-

ness in the manufacture, it may contain certain metallic salts.

As most of these varieties of vinegar naturally contain minute proportions of certain salts which affect the reagents employed in the detection of the adulterants, the processes are more complicated than those which are applicable to acetic acid. Vinegar being largely employed in domestic economy and the arts, it will be useful to present these processes in detail. They are principally drawn from the work of Garnier and Harel, *Des Falsifications des Substances Alimentaires*.

Detection of Sulphuric Acid.—Take a known quantity of the suspected vinegar, a pint for example, put it into a porcelain capsule and evaporate it by a gentle heat to one-eighth its volume. Add to the concentrated liquid, when cool, five or six times its volume of spirit of wine, and stir the liquid with a glass rod. The alcohol will dissolve the acid, and cause the precipitation of the salts which it held in solution. Filter the alcoholic liquor and wash the insoluble matter which remains on the filter with alcohol. To the clear filtered solution diluted with water, add chloride of barium in excess. If any sulphuric acid is present a white precipitate will be formed which is insoluble in nitric acid.

There is said to be a kind of vinegar in France which gives an abundant precipitate with chloride of barium, but which, however, does not contain free sulphuric acid. It is a mixture of wine vinegar with a vinegar prepared from the syrup of fecula, and from the *eaux de bac*. This vinegar treated with alcohol does not yield free sulphuric acid; the precipitate caused by the chloride of barium, before the addition of alcohol, is due to the presence of sulphate of lime.

Detection of Muriatic Acid.—As the purest vinegar often contains a certain quantity of chlorides, as well as sulphates,

the presence of free muriatic acid is determined as follows. A known quantity of the suspected vinegar, say a pint, is introduced into a tubulated retort, to which an adapter and receiver are attached. The liquid is then distilled to near dryness, and it passes into the receiver, which must be kept cool. The distilled liquid is treated with a solution of nitrate of silver, which causes no precipitate when the vinegar has not been mixed with muriatic acid, but produces a more or less abundant one when this acid has been added to it.

Detection of Nitric Acid.—The adulteration of vinegar by nitric acid is of rare occurrence. We can determine its presence in vinegar by carbonate of potassa. When the suspected liquor is saturated with the salt and evaporated to dryness we obtain a saline mass, which, if it contains nitrate of potassa, will burn with scintillations when thrown upon burning charcoal. This mass, also, when mixed with copper filings, and treated with sulphuric acid, will cause the disengagement of reddish vapors of nitrous acid, if a nitrate is contained in it.

Another process for the detection of nitric acid in vinegar has been recently proposed. Put into a capsule some drops of the suspected vinegar, and into the liquid introduce a few scrapings or cuttings of the barrel of a writing quill. If upon the application of heat the organic matter acquires a yellow colour, it is certain that the vinegar contains nitric acid.

Detection of Tartaric Acid.—Vinegar is sometimes adulterated with water acidulated with tartaric acid. One part of crystallized tartaric acid in twenty-four parts of water, gives a liquor which has the same specific gravity as good vinegar. This solution is often sold in France under the name of *Verjuice*.

For the purpose of detecting the presence of tartaric acid evaporate a portion of the suspected vinegar to about

three-fourths of its volume, and when cool, filter the solution and add solution of acetate of potassa. If tartaric acid is mixed with the vinegar, crystals of cream of tartar are slowly formed, the quantity of which is increased by agitation. No such precipitate is obtained if the vinegar is pure.

The presence of tartaric acid in vinegar can also be determined by saturating the suspected liquor with potassa. Upon adding to the saturated liquid a solution of chloride of barium, or chloride of calcium, if the vinegar contains tartaric acid, we obtain a precipitate of tartrate of lime, or tartrate of baryta, which is not the case when pure vinegar saturated with potassa is employed.

Detection of Oxalic Acid.—The adulteration of vinegar with oxalic acid is, probably, quite rare, although it is mentioned by some authors. It may be easily detected by saturating the suspected vinegar with ammonia, and then adding to the saturated liquor a solution of a soluble salt of lime, when, if the vinegar is adulterated with oxalic acid, there will be an abundant precipitate of oxalate of lime. To distinguish between oxalic and tartaric acids, lime water may be used, which instantly gives a precipitate with the former, but not with the latter, unless added until alkaline reaction is produced.

Detection of Acrid Substances.—These are sometimes added for the purpose of increasing the pungency of the vinegar. They can generally be detected by their peculiar taste, and by the irritation which they occasion when taken into the mouth, or applied to the lips. They may also be detected by evaporating the vinegar at a gentle heat to the form of an extract: this extract of vinegar, to which pepper, pellitory, &c., has been added, has an acrid, piquant and caustic taste, which is not possessed by the extract produced by pure vinegar.

Detection of Metallic Salts.—Vinegar sometimes contains salts of copper, lead and zinc. The presence of these salts is due to the employment in its manufacture of instruments made of copper, lead and brass, and to the use of metallic faucets. The following are the tests :—

The yellow ferrocyanide of potassium gives a white precipitate with the salts of zinc, and a reddish-brown precipitate with the salts of copper.

The iodide of potassium gives a yellow precipitate with the salts of lead.

Sulphuretted hydrogen causes with the salts of lead and of copper a precipitate of a brown or black color.

Chromate of potassa gives a fine yellow precipitate with a salt of lead.

ACONITINE, OR ACONITIA.

Aconitum, U. S.

The active principle of the Monkshood, *Aconitum Napellus* L., a plant found in the mountainous parts of Europe and extensively cultivated in gardens. It is extracted from the leaves and root of the plant, and usually occurs in the form of a colourless and somewhat vitreous mass. It has a sharp and bitter taste and an alkaline reaction. It is soluble in alcohol, ether and the acids, and when heated on platinum foil it is speedily and entirely dissipated. It is one of the most deadly poisons, although in minute doses used medicinally.

According to Pereira a spurious aconitine is found in the shops. It is imported from France and bears the stamps and label of a celebrated French chemical firm. Its colour is grayish yellow. It is inert or nearly so, is not completely soluble in alcohol or ether, and when burnt on platinum foil leaves a calcareous residue.—(*Elements of Materia Medica.*)

ADEPS.—See HOG'S LARD.

ALCOHOL.

Alcohol, U. S.

A limpid, colourless liquid, having a penetrating odour and burning taste. The lightest that can be obtained by simple distillation has a specific gravity of 0.825, but by the intervention of substances that strongly attract water, it has been brought to the specific gravity of 0.790, at 60° F. In that state it boils at 168° F., and does not become solid even in the most intense cold.

The spirituous products which are obtained from fermented liquors by the ordinary processes of distillation have received various names. Thus, *brandy* is obtained from wine; *rum*, from molasses or the juice of the sugar-cane; *whiskey*, from barley, rye and potatoes; *gin*, from beer and fermented cereals, with the addition of juniper-berries; *arrack*, from fermented rice, &c. The intoxicating properties of all these liquors depend upon the proportion of pure alcohol which they contain.

As alcohol is specifically lighter than water, all the processes for determining its proportion in mixtures of alcohol and water, have for their object some mode of ascertaining the specific gravity of these mixtures. For this purpose a convenient instrument has been devised by Gay Lussac, called the *Centesimal Alcometer*. The scale of this instrument is divided into 100 equal parts; of which 0 corresponds to pure water and 100 to absolute alcohol, at a certain temperature; so that when it is introduced at this temperature into a liquor containing equal volumes of water and of absolute alcohol, it will sink to the line of 50°. Thus also in every other case the proportion of absolute alcohol and water will be indicated by the degree which corresponds to the level

of the liquid under examination. Suppose, for example, a pipe containing 126 gallons filled with brandy, in which the alcoometer stands at 55° , at 59° F., (15° Cent., the temperature assumed as the standard by Gay Lussac, and this temperature being attained either by warming the sample with the hand or cooling it by plunging the vessel which contains it in well water,) the pipe will contain 69.3 gallons of absolute alcohol. For, $100 : 55 :: 126 : 69.3$.

As the specific gravity of absolute alcohol is well known, and tables have been constructed showing the specific gravities of various mixtures of alcohol and water at a common temperature, the proportion of alcohol in any mixture may also be determined by a *thousand grain bottle*, an instrument constantly employed in the analysis of mineral waters.

The following table shows the density of absolute alcohol and of mixtures of alcohol and water at 59° F.

| Alcohol in 100 parts. | Densities of the liquor. | Alcohol in 100 parts. | Densities of the liquor. |
|--------------------------|-----------------------------|--------------------------|-----------------------------|
| 100 | 0.7947 | 60 | 0.9141 |
| 95 | 0.8163 | 55 | 0.9248 |
| 90 | 0.8346 | 50 | 0.9348 |
| 85 | 0.8502 | 45 | 0.9440 |
| 80 | 0.8643 | 40 | 0.9523 |
| 75 | 0.8779 | 35 | 0.9595 |
| 70 | 0.8907 | 30 | 0.9636 |
| 65 | 0.9027 | | |

The brandy of commerce has a brownish yellow colour which it acquires by being kept in hogsheads of oak. This kind of liquor always contains an extractive principle and tannic acid, to which it owes the property of being blackened when a few drops of a solution of persulphate of iron are added to it.

In France, the retailers often sell, under the name of brandy, alcohol diluted with water, and coloured with a little caramel. This liquor differs from genuine brandy in its taste, and in not changing its colour upon the addition of persulphate of iron.

Brandy often contains a small quantity of copper, derived from the distillatory apparatus, dissolved by the acid contained in the liquor. The presence of this metal in the state of a salt, can be detected by solution of ammonia, and by a clean plate of iron. After decolourizing the brandy by animal charcoal, ammonia gives to the liquor, if it contains copper, a fine blue colour, which sometimes, however, appears only at the end of several hours. A piece of iron properly cleansed and put in contact with such a liquid, is covered with a coating of metallic copper. M. Chevallier has found copper in many specimens of brandy, and is said to have in his possession a nail taken from a pipe of that liquor which was so charged with copper that it appeared to be made of this metal.—(*Garnier and Harel.*)

Brandy sometimes contains lead. This metal, which is found in the form of a salt, is derived either from the solder or from the capital of the still. It has also been recently ascertained that a solution of acetate of lead is sometimes added to this liquor to facilitate its clarification. The presence of this metal can be detected by evaporating the liquor to one half its volume in a porcelain capsule, and then adding to separate portions of it a solution of sulphate of soda and of sulphuretted hydrogen. The first of these causes a white precipitate of sulphate of lead: the second a black precipitate of the sulphuret of lead. To determine whether acetate of lead has been added, the liquor should be evaporated nearly to dryness, when if that salt is present, the addition of sulphuric acid will liberate acetic acid which may be recognized by its odour.

Acrid substances are sometimes added to brandy and weak alcohol. This fraud can be easily detected by evaporating a portion of the liquor to dryness, when the acrimony is at once perceptible to the taste.

Dr. Ure states that various frauds are practiced in the introduction of alcohol into Great Britain on account of its

high price there, and the high duty imposed upon it. Sometimes it is introduced under the mask of oil of turpentine, from which it can be sufficiently freed by rectification for the purpose of the gin manufacturer. Sometimes it is disguised with wood naphtha, wood vinegar, or with coal naphtha. From wood vinegar and coal naphtha it may be separated by distillation on account of the difference between the boiling points of the two liquids. Coal naphtha does not combine with water as alcohol does.

When the object is to discover whether wood spirit contains alcohol, we may proceed as follows: Add to the suspected liquid a little nitric acid, of specific gravity 1.45. If alcohol is present, in even small proportion, an effervescence will ensue from the evolution of etherized nitrous gas, with its characteristic ethereal smell. Pure wood spirit when mixed with nitric acid, becomes of a ruby tint, but remains tranquil. Alcohol continues colourless, but enters into violent ebullition, and is nearly all dissipated in fumes. The mixture of wood spirit with alcohol may also be detected by the addition of caustic potassa, a little of which, in powder, causes wood spirit to become speedily yellow and brown, while it gives no tint to alcohol. According to Dr. Ure, in this way one per cent. of wood spirit may be discovered in any sample of spirits of wine.

The alcohol distilled from damaged grain sometimes contains a peculiar volatile body, which, when the spirit is in a hot state, irritates the eyes and nose. It has nearly the same smell as alcoholic solution of cyanogen. Such spirits intoxicate more strongly than pure spirit of the same strength, and excite in many persons even a temporary frenzy. Dr. Ure says he separated it in cold weather at some of the great distilleries in Scotland, and then found it to be a volatile fatty matter, of a very fetid odour. At the end of a few months, it spontaneously decomposes in the spirits and leaves them in a less nauseous and noxious state.

The greater part of the oil may be separated by largely diluting the spirits with water and distilling at a moderate temperature.--(*Dictionary of Arts, &c.*)

ALOES.

Aloe, U. S.

The substance, known in commerce under the name of *aloes*, is the extract of several species of *Aloe*, as *A. spicata* L., *A. socotrina* D. C., *A. vulgaris* D. C., and *A. arborescens* D. C. The Socotrine is made in the various islands in the Straits of Babelmandel, but being originally brought from Socotra, one name is given to the whole. The *A. spicata* is extensively cultivated at the Cape of Good Hope, and such large quantities of it are exported that it is said to have nearly driven the Socotrine from market, (*Burnett's Outlines of Botany.*) Aloes is also obtained from Barbadoes, where it is made from several different species: it is in general a less pure and slightly drug than either the Socotrine or the Cape. Socotrine aloes has a brilliant reddish brown colour, is usually translucent, has a smooth conchoidal fracture, an aromatic, agreeable odour, and an intensely bitter and nauseous taste. It affords a golden yellow powder. It is almost entirely soluble in boiling water and in common alcohol. As usually obtained, it is of a darker colour, more opaque, and has a more disagreeable taste and odour. It is sometimes adulterated by being mixed with common resin, a fraud which can be detected by the insolubility of such aloes in boiling water.

Cape Aloes, when freshly broken, has a dark olive or greenish colour, approaching to black; it has an almost glassy fracture, and is translucent at the edges. The powder is of a fine greenish yellow colour; its odour is strong and disagreeable, but not nauseous. In cold weather it is brittle, and easily reduced to powder, but in very hot weather it is apt

to become soft and tenaceous. The superiority of this variety is said to be entirely owing to the care observed in the evaporation, and in avoiding the intermixture of earth, stones and other impurities.

Barbadoes Aloes.—This is supposed to be more active than the Socotrine aloes, and is hence used by farriers; it is on this account called *Cabilline aloes*. It is usually of a darker colour, and is more opaque than the Socotrine aloes; it has also a tougher consistence, and a more disagreeable odour. It leaves a considerable residue when acted on by boiling water and alcohol, by which means it can be distinguished from the other kind which dissolves almost entirely in these menstrua.

ALUM.

Alumen, U. S.

The term *alum* is now applied to several different kinds of salts. The most common of these are the sulphate of alumina and potassa, sulphate of alumina and soda, and sulphate of alumina and ammonia. These may be distinguished from each other by exposing portions of them to the action of a blow-pipe. Soda alum produces a rich yellow flame; potash alum a weak violet flame; ammonia alum a transient green flame, and an odour of ammonia.

Common alum (the sulphate of alumina and potassa) usually crystallizes in regular octahedrons frequently with truncated edges and angles, and sometimes in cubes. It has an astringent and sweetish acid taste, and an acid reaction on vegetable blues. By exposure to the air it effloresces slightly, and when heated it undergoes watery fusion, swells up, and is converted into a white spongy mass called *burnt alum*. It dissolves in eighteen parts of cold, and less than its own weight of boiling, water.

Alum should be colourless, and completely soluble in water, which proves the absence of earthy matter. Solution

of potassa or soda should form a colourless precipitate of hydrate of alumina, soluble in an excess of the alkali. If the alum is mixed with sulphate of iron, which is sometimes the case, the precipitate formed by the addition of potassa or soda, is not entirely soluble in excess of the alkali; and the portion which remains undissolved is either of a red brown colour, or becomes so by exposure to the air. The presence of iron greatly injures alum for some purposes.

AMBER.

Succinum, U. S.

This resin is of various shades of yellow or brown, transparent or translucent, with a specific gravity of 1.06 to 1.07. When heated it swells and burns, exhaling a white smoke of a pungent odour, but it does not run into drops. It is by these tests that amber may be distinguished from copal and other resins with which it is sometimes mixed. When pure, sixteen ounces of amber yield about half an ounce of succinic acid, three ounces of oil, and ten ounces of torrefied resin, fit for amber varnish.

AMMONIA.

Ammoniae Liquor, U. S.

The pure liquor, or solution, of ammonia, is a perfectly colourless liquid, and has a specific gravity of 0.93. It must have a pure ammoniacal odour, and when evaporated upon a watch glass must not leave the slightest residue. It ought not to be troubled by the addition of lime water, otherwise it contains carbonate of ammonia. When supersaturated with nitric acid, it should give no precipitate with chloride of barium, otherwise it contains sulphuric acid. If this solution gives a precipitate with nitrate of silver, it probably contains sal ammoniac; if with oxalic acid, lime; and if it is coloured by sulphuretted hydrogen, it contains some metal.

It is difficult to obtain a solution of ammonia quite free from carbonic acid, and the presence of that substance in small quantity presents no difficulty for pharmaceutical uses. For certain chemical purposes it requires to be as pure as possible. It should be kept in bottles, accurately closed with glass stoppers.

AMMONIA, ACETATE OF, (SOLUTION.)

Liquor Ammoniae Acetatis, U. S.

This is a solution obtained by the addition of sesquicarbonate of ammonia to distilled vinegar, until there is only a very slight excess of acid. When pure, the liquid is colourless, and should leave no residue on the application of heat. Upon the addition of strong sulphuric acid it evolves vapours of acetic acid, and if potassa or lime be mixed with it, ammonia is given out when gently heated.

This solution may contain muriatic acid, sulphuric acid, or some metal. Nitrate of silver will give a white precipitate if the first is present; chloride of barium will give a white precipitate, insoluble in nitric acid, if it contains sulphuric acid. The discolouration produced by sulphuretted hydrogen will indicate the presence of a metal. If chloride of barium gives a white precipitate, soluble in an acid, or if acetate of lead produces a white precipitate, also soluble in nitric acid, it is due to the presence of carbonic acid.

AMMONIA, MURIATE OF.

Murias Ammoniae, U. S.—*Sal Ammoniac*.

This substance generally occurs in the form of hard, colourless and translucent cakes, having a somewhat fibrous structure. It has a sharp taste, is soluble in about three parts of water at 60°, and in an equal weight at 212°. It is also soluble in alcohol. Exposed to a heat below that of ignition, it sublimes without fusion or decom-

position, and condenses on cool surfaces. When rubbed with quicklime it gives out the odour of ammonia.

The impurities generally found in muriate of ammonia are sulphate of ammonia, sulphate of soda, chloride of sodium, and occasionally the oxides of lead, iron and copper. If it sublimes without residue, while its solution gives with chloride of barium a white precipitate insoluble in nitric acid, it contains sulphate of ammonia. If it leaves a residue upon being subjected to heat, it may contain sulphate of soda, or chloride of sodium. These substances are often found in unpurified sal ammoniac, to the amount of ten per cent. The presence of metals may be determined by the change of colour produced in a solution of the sal ammoniac by sulphuretted hydrogen, or hydrosulphuret of ammonia.

AMMONIA, NITRATE OF.

This is the salt employed in the preparation of the protoxide of nitrogen. It sometimes is met with in the form of six-sided crystals terminated by six-sided pyramids, in which state it is deliquescent and frequently contains an excess of acid. Sometimes the crystals are thin and fibrous, and sometimes, in consequence of the evaporation being carried farther, it forms a compact and shapeless mass. It is soluble in twice its weight of water at 60°; has an acid and bitter taste; undergoes watery fusion when exposed to heat. It is liable to be contaminated with muriate of ammonia and the gas obtained from it is sometimes mixed with the vapour of nitrous acid. (See NITROGEN, PROTOXIDE OF.)

AMMONIA, OXALATE OF.—See APPENDIX.

AMMONIA, SESQUICARBONATE OF.

Ammoniae Carbonas, U. S.—*Smelling Salts*.

This salt usually occurs in white, very hard, masses, of a fibrous crystalline structure, which effloresce and fall to pieces in the air. It has a strong ammoniacal odour,

which, however, must not be disagreeable and empyreumatic.

Pure carbonate of ammonia yields a colourless solution in water, and completely evaporates when heated in a platinum spoon. After supersaturation with nitric acid, it must not be precipitated by solution of chloride of barium, nor by solution of nitrate of silver, nor by sulphuretted hydrogen.

Carbonate of ammonia is often employed by bakers in the preparation of bread. That which is prepared from the liquor produced in gas-works is unfit for this purpose, as it has a disagreeable odour, from which it is difficult to free it.

AMMONIA, SPIRIT OF.

Ammonia Spiritus, U. S.

This is a solution of ammonia, or more commonly of carbonate of ammonia, in rectified spirit diluted with water. It is entirely unfit for most chemical uses, although it may be substituted for the solution of ammonia in pharmacy. In its pure form it is obtained by distillation.

It is sometimes imitated by dissolving sal ammoniac, potassa and empyreumatic oil in water, without submitting the solution to the process of distillation. The two compounds may be distinguished from each other, by evaporation in a platinum spoon. The pure spirit of ammonia will leave scarcely any residue, while the other will leave a residue of chloride of potassium. Spirit of ammonia is said usually to contain a little hydrocyanic acid. This may be determined by neutralizing the liquid with muriatic acid and adding a solution of sulphate of iron. If hydrocyanic acid is present a blue precipitate will be formed.

AMMONIAC.

Ammoniacum, U. S.

This gum resin is an exudation from a plant which grows in Persia called by Mr. Don, *Dorema Armeniacum*. The

plant is about seven feet high, and sometimes seven or eight inches in circumference near the root. The exudation is in the form of a milky juice which concretes on the stem and when it becomes solid is collected by the inhabitants for exportation.—(*Burnett's Outlines of Botany.*) 2, 77.

Ammoniac occurs in market either in small tears clustered together, yellowish on the outside and whitish within, with numerous whitish tears, or in brownish lumps. It has a peculiar odour, not unlike that of assafœtida, and a bitterish, somewhat acrid taste. The specific gravity is 1.207. When heated it softens, becomes adhesive, but does not melt. It burns with a white flame, and emits during combustion a strong resinous, slightly alliaceous odour. It forms a white emulsion with water, is soluble in vinegar, and partially so in alcohol, ether, and solutions of the alkalies. It contains many impurities, as seeds, fragments of vegetables, and earthy matters. Some of these can be detected by their want of miscibility in water and solubility in vinegar.

ANIMAL CHARCOAL.—See CHARCOAL.

ANIMÉ.

A resin of a pale brown yellow colour, transparent and brittle. It is the produce of several species of *Hymenæa*, especially *H. Courbaril* L. and *H. Martiana*, trees which grow in various parts of South America. It occurs in pieces of various sizes, and sometimes filled with insects of different kinds belonging to living species. According to Dr. Ure it contains about one-fifth of one per cent. of a volatile oil which gives it an agreeable odour. Alcohol does not dissolve the genuine animé, nor does caoutchoucine; but a mixture of the two in equal parts softens it into a tremulous jelly, though it will not produce a liquid solution. When reduced to this state the insects may be picked out without injury to their most delicate parts. Specific gravity from 1.054 to 1.057. Exposed to heat in a Florence

flask it softens, and by careful management, may be brought into liquid fusion without discolouration. It then exhales a few white vapours, of an ambrosial odour, which being condensed in water, and the liquid being tested, is found to be succinic acid.—(*Ure's Dictionary of Arts, &c.*)

ANISEED.

Anisum, U. S.

The seed of the *Pimpinella anisum* L., a native of the Island of Scio and Egypt, but largely cultivated in Spain and various parts of Germany. It is ovate-oblong, gibbous convex, anteriorly flattish, and has a greyish-green colour, and a warm and sweetish taste. It must be free from mustiness, and when rubbed between the hands should give out its peculiar aromatic odour. The heavier the seed is, the more oil it contains. It is said that the small, compact, Spanish seed is preferable to the lighter and larger kind elsewhere grown.

ANNOTTO, OR ARNOTTO.

This well-known dye is prepared from the red pulpy matter that surrounds the seeds of the *Bixa orellana* L. a tree of tropical America. It occurs in the form of a somewhat dry and hard paste, brown without and red within. It is imported in cakes of two or three pounds weight, wrapped up in leaves of large reeds, packed in casks. This drug is extensively used by the Spaniards to heighten the flavour, and impart a rich colour, to their soups and chocolates, and is employed in England and Holland to give a fine red colour to cheese. It is also used as a dye for silks. Occasionally it is mixed with red lead, or at least a mixture of red lead and other substances has been employed as a substitute for annatto in the colouring of cheese. This dangerous substitution, arising probably from ignorance of the na-

ture of red lead, can be detected by dissolving the suspected substance in nitric acid and adding liquid sulphuretted hydrogen to the solution. If lead is present, a black precipitate of sulphuret of lead will be produced.

ANTIMONY.

A brittle metal, of a silvery white colour, scaly texture, and possessing considerable lustre. It fuses at about 800° F. and is volatile at a white heat. When placed on ignited charcoal, under a current of oxygen gas, it burns with great brilliancy, giving off an oxide in the form of a dense yellow smoke. Commercial antimony almost always contains arsenic, the presence of which can be detected by the garlic smell emitted by such an alloy when heated by the blow-pipe; or the presence of arsenic may be detected by dissolving the mixed metals in nitromuriatic acid, and then passing through the solution a current of sulphuretted hydrogen. The orange-red precipitate of sulphuret of antimony is first deposited, and afterwards the bright yellow precipitate of sulphuret of arsenic. The current of sulphuretted hydrogen gas is to be continued until the solution is completely saturated, and the solution is to be afterwards heated to cause the entire precipitation of the sulphurets. The solution is now filtered, and the mixed sulphurets are to be defragrated with carbonate of soda and nitre in a crucible, the mass treated with water, filtered, and afterwards treated with nitric acid, to decompose the basic alkaline antimonates which the filtrate contains in solution to a small extent. By this means almost all the antimony is obtained as an insoluble, and all the arsenic as a soluble, compound. Water digested upon the mixture, filtered, and then tested with nitrate of silver, will give the brown-red precipitate characteristic of arsenic acid. If the solution is slightly acidulated with muriatic acid, sulphuretted hydrogen will produce a bright yellow precipitate, especially if heat be applied. From

this precipitate metallic arsenic may be obtained, by mixing it with equal parts of cyanide of potassium and carbonate of soda, and subjecting the mixture to a strong heat in a test tube. In a case of poisoning, by arsenic, several precautions are necessary in consequence of the organic substances mixed with it, which may here be omitted. Minute directions for obviating the difficulties which such investigations present, will be found in almost all the recent chemical treatises. I would refer the inquirer, especially, to Fresenius's Work on Chemical Analysis.

Antimony is frequently contaminated with iron, copper and lead. These may be detected by dissolving the metal in nitro-muriatic acid, precipitating the oxichloride by the addition of water, and then treating the clear and filtered solution with carbonate of potassa. The precipitate may contain iron, copper, lead and antimony. Treat it with nitric acid, which will dissolve all except the antimony. The addition of sulphuric acid will give a white precipitate of sulphate of lead. Liquid sulphuretted hydrogen will give a black or brown precipitate of sulphuret of copper; and excess of ammonia will cause the separation of brown-red flocks of peroxide of iron.

ANTIMONY, OXYSULPHURET OF.

Antimonii Oxysulphuretum, L.

Under this name are included certain products obtained by subjecting the native sulphuret of antimony to the action of heat and acids, and concerning the precise nature of which chemists are not agreed. These are *Glass of Antimony*, *Saffron of Antimony* and *Liver of Antimony*. *Kermes Mineral* and *Golden Sulphuret of Antimony* are analogous compounds. They are all objectionable for medicinal use in consequence of the variable proportions of sulphuret and oxide of antimony which they contain.

As the native sulphuret is the substance from which these preparations are obtained, they may all contain a minute quantity of arsenic. The presence of this metal may be detected by the process already described. Professor Brande states that in the glass of antimony brought into England for pharmaceutical purposes from Germany and Holland, there is usually a portion of silicious earth, and that it is sometimes adulterated with oxide of lead. This fraud is detected by dissolving the finely-powdered glass in muriatic acid. Silica, or brick-dust, with which it may be also be mixed, will remain unacted on. If it contains oxide of lead, the filtered solution, when diluted with water, will give a white precipitate on the addition of sulphate of soda. If a blue precipitate is produced in a solution of this, or of any of the above compounds upon the addition of ferrocyanide of potassium, the presence of iron is indicated. Organic substances may be detected by the empyreumatic odour which is given out when the compound is subjected to heat in a glass tube. If sulphate of potassa is mixed with it, solution of chloride of barium, added to the diluted muriatic solution of the compound, will cause a white precipitate, insoluble in nitric acid.

Recently the oxysulphuret of antimony has been found to be largely adulterated with sulphate of lime, in consequence of boiling the sulphuret of antimony with lime instead of a solution of potassa. On the addition of sulphuric acid, the oxysulphuret of antimony is precipitated with about thirty per cent. of sulphate of lime. The latter substance may be detected by boiling the suspected oxysulphuret in water, and testing portions of the filtered solution with chloride of barium and oxalate of ammonia. If sulphate of lime is present, white precipitates will be produced by the addition of these tests.—(*The Chemist, February, 1846.*)

ANTIMONY, SESQUIOXIDE OF.

Antimonii Oxidum, E.

This substance, used for the preparation of *Tartar Emetic*, may be obtained by adding to an acid and boiling solution of antimony in muriatic acid, carbonate of soda in excess, washing the precipitate with cold water until it ceases to redden litmus paper and then drying it over a vapour bath. It is a powder of a dirty white colour, which fuses at a red heat and forms on cooling an opaque crystalline mass. It is volatile and may be sublimed in close vessels by a strong heat.

The presence of arsenic, sometimes found in this as well as in other antimonial preparations, may be proved by boiling the suspected powder in water slightly acidulated with muriatic acid. The filtered solution is then to be tested with ammonia-nitrate of silver, ammonia-sulphate of copper, and sulphuretted hydrogen. If arsenic is mixed with the oxide of antimony, the first test will give a light yellow precipitate, the second a green, and the last a bright yellow one. The solution may also be evaporated, and the powder mixed with powdered charcoal put into a glass test tube, and subjected to the heat of a spirit lamp. If arsenic is present the garlic odour will be given out, and a brilliant metallic sublimate produced in a cool part of the tube, which by heat and air is again converted into arsenious acid.

The mixture of iron with the oxide of antimony may be detected by dissolving the powder in muriatic acid, precipitating it by the addition of water, and then adding solution of ferrocyanide of potassium to the clear liquor. A blue precipitate will be formed, either immediately or after a short exposure to the air, if any iron is present. If the oxide of antimony is mixed with silica, it will not be entirely soluble in muriatic acid.

ANTIMONY, SESQUISULPHURET OF.

Antimonii Sulphuretum, U. S.—*Crude Antimony*.

This compound of antimony, which occurs native, is found in the form of masses having a brilliant lead grey, or steel grey colour, and a radiated or fibrous crystalline structure. It is said to be rarely free from sulphuret of arsenic, which is the source of that metal found in the various antimonial preparations. It also frequently contains sulphuret of iron. The presence of these substances may be detected by the processes already described.

Dr. Ure recommends the fusion of the sulphuret of antimony with three-fourths of its weight of cyanide of potassium in a porcelain crucible over a spirit lamp, when a regulus of antimony is obtained. The metal may then be easily tested for arsenic, since none of this volatile substance can have been lost, owing to the low temperature employed. —(*Dictionary of Arts, &c.*)

The sesquisulphuret of antimony should always be purchased in mass, as its properties cannot be well judged of when it is in powder.

ANTIMONY AND POTASSA, TARTRATE OF.

Antimonii et Potassæ Tartras, U. S.—*Tartar Emetic*.

This salt occurs in rhombic octahedrons, with many secondary planes, which, on being pulverized, produce a white powder. It is transparent at first, but by exposure it loses water, and becomes opaque. It is soluble in about fourteen or fifteen parts of cold, and two of hot, water; insoluble in alcohol. When heated in a porcelain or glass capsule the salt is charred, owing to the presence of tartaric acid, and sulphuretted hydrogen passed through a solution of it causes an orange-red precipitate, from which metallic antimony can be obtained. It should be kept in the

state of powder, to prevent loss of weight from the escape of water, and to ensure uniformity in the strength of its doses.

Tartar emetic frequently contains tartrate of lime, tartrate of iron, tartrate of potassa, and bitartrate of potassa. The latter is particularly liable to be found in the tartar emetic manufactured according to the process recommended by Mr. Phillips. Arsenic is also occasionally found in it as in the other antimonial preparations, the presence of which can be determined as already described.

If tartar emetic does not dissolve in fifteen parts of cold water, it may contain tartrate of lime or bitartrate of potassa. Dissolve this residuum in hot water, and test the solution with sulphuretted hydrogen, to ascertain whether any metallic salts are present.

According to Mr. Hennell, however, the antimonial salt may contain 10 per cent. of bitartrate of potassa, and yet the whole will dissolve in the proper quantity (about 15 parts) of water. In order to detect any uncombined bitartrate, he adds a few drops of a solution of carbonate of soda to a boiling solution of the antimonial salt, and if the precipitate formed be not dissolved, he concludes that there is no bitartrate of potassa present.—(*Pereira's Elements of Materia Medica.*)

The solution of tartar emetic in water must be perfectly colourless, and exhibit no tint of yellow, otherwise it contains iron. The presence of this metal may also be detected by the blue precipitate which is formed on the addition of a solution of ferrocyanide of potassium, a few drops of sulphuric acid being previously added. If the solution gives a white precipitate with nitrate of silver, it contains muriatic acid. If it gives with a solution of chloride of barium, a precipitate insoluble in nitric acid, it contains sulphuric acid. When tested with sulphuretted hydrogen or hydrosulphuret of ammonia, it must give a pure orange-coloured, and never any black, precipitate.

When tartar emetic dissolves in less than fifteen parts of water it probably contains neutral tartrate of potassa. It should always, if possible, be bought in crystals.

ANTIMONIAL WINE.

Antimonii Vinum, U. S.

This should be recently prepared, because all solutions of tartar emetic are very liable to undergo spontaneous decomposition. It ought to be clear and without deposit. If it has undergone decomposition, it will contain no antimony; which may be proved by passing through a portion of it, diluted with water, a current of sulphuretted hydrogen, or by adding to it some hydrosulphuret of ammonia. The presence of antimony is proved by the orange coloured precipitate which is produced upon the application of this test.

ARGENTUM.—See SILVER.

ARROW-ROOT.

Maranta, U. S.

A farinaceous substance obtained from the root of the *Maranta arundinacea* L., a plant growing in the West Indies. When pure it is in the form of a light white powder, or small pulverulent masses, having a firm feel if pressed between the fingers, and entirely destitute of taste or smell. It is a kind of starch, but is much more nutritious and digestible than that from wheat or potatoes; it differs also in physical properties. It is exported from most of the West India Islands in tin cases, and in barrels and boxes.

A cheap imitation of arrow-root is manufactured from potatoe starch. This fraud can be detected by the microscope. Arrow-root consists of regular ovoid particles of nearly equal size, while potatoe starch consists of particles

of an irregular ovoid or truncated form, very irregular in their dimensions. The particles of arrow-root are also much smaller and free from the streaks and furrows seen in potatoe starch by a good microscope. Dilute nitric acid, triturated in a mortar with potatoe starch, forms immediately a transparent, very viscid paste or jelly. Flour starch exhibits a similar appearance. Arrow-root, however, forms an opaque paste, and takes a much longer time to become viscid. Arrow-root, moreover, is destitute of that fetid, unwholesome oil, extractable by alcohol from potatoe starch. Perhaps the best tests of the purity of arrow-root, are its white colour and the entire absence of taste or smell.

The "East Indian arrow-root" is obtained from the tuber of the narrow-leaved turmeric *Curcuma angustifolia* Roxb., brought from Calcutta, Para, Maranham and Sierra Leone. Two kinds are met with in commerce, the *white* and the *pale buff-coloured*. The first is a fine white powder, readily distinguishable, both by the eye and touch, from West Indian arrow-root. In appearance it somewhat resembles a finely-powdered salt (as bicarbonate of soda or Rochelle salt.) The pale, buff-coloured East Indian arrow-root is in the form of powder or pulverulent masses, mixed with husks, woody fibre and other impurities. Both kinds present the same appearance under the microscope.—(*Parnell's Applied Chemistry*.)

The fecula known as the Brazilian arrow-root, is obtained from the tuberous root of the *Jatropha Manihot* L.; and the "Portland arrow-root" is derived from the *Arum maculatum* L.—(*Ibid.*)

ARSENIC.

This is a very brittle metal, having a strong metallic lustre, a steel-grey colour, and a crystalline structure. At 356° F. it volatilizes without being fused, and in close vessels may be collected unchanged. When thrown upon hot

coals it burns with a blue flame and a white smoke, and a strong smell of garlic is perceived. As usually met with in the shops it has a dull grey colour, owing to partial oxidation at the surface. In this state it is often known by the name of *fly powder*, and is also sometimes sold as *cobalt*.

The purity of arsenic may be determined by its volatility. If put into a tube of hard glass closed at one end and subjected to a heat below redness, the arsenic, if pure, will be entirely volatilized. Cobalt and iron, with which it may sometimes be mixed, will remain unaffected by the heat. Antimony requires a white heat for its conversion into vapour.

In all the experiments upon arsenic or its compounds the operator should be careful not to inhale any of the fumes which may be given out.

ARSENIC, YELLOW SULPHURET OF.

Orpiment.

This compound has a rich yellow colour, is insoluble in acids, but soluble in pure alkalies, yielding colourless solutions. It is the colouring principle of the pigment called *King's Yellow*. A compound is sometimes sold under this name which is nothing more than arsenious acid combined with a little sulphur. It is quite soluble in water, which is not the case with the properly prepared orpiment. Although poisonous, the real sulphuret of arsenic is less virulent than arsenious acid, and hence this sophistication may sometimes be productive of very injurious effects. The *Realgar*, or red sulphuret of arsenic, is sometimes imitated by a mixture of arsenious acid, sulphur and charcoal.

ARSENIOUS ACID.

Acidum Arseniosum, U. S.—*White Oxide of Arsenic*.

A transparent and colourless substance, having a vitreous fracture, which gradually becomes milk-white and opaque.

Its specific gravity is from 3.698 to 3.738. It sublimes at 380° F., without softening or fusing; and when the operation is conducted slowly in a glass tube, transparent octahedral crystals are obtained, having an adamantine lustre. It is sparingly soluble in water, and more so in hot, than in cold; reddens vegetable blue colours.

Most commonly arsenious acid occurs in the shops in the form of a white powder, and it is often mixed with chalk and sulphate of lime. Pure arsenious acid, when heated in an iron spoon, volatilizes without residue. If it contains chalk or sulphate of lime they remain behind. The adulterated arsenious acid can never be safely employed in medicine, as its preparations are of uncertain strength and cannot be relied on. It should, if possible, be purchased in the massive form.

ASSAFÆTIDA.

Assafætida, U. S.

This is a gum resin, the produce of the *Ferula assafætida* L., a native of Persia. The best kind is found, in commerce, in large lumps, composed of irregular agglutinated masses, which have a tough consistence, and a very mottled appearance, in consequence of the presence of drops or tears of a white, red and brown tint, all mixed together. It has a very fetid, alliaceous odour, and a bitter, acrid taste. By long keeping it becomes more hard and brittle, and the intensity of its taste and smell is diminished. An inferior kind, sometimes met with, is full of sand, and has a very fetid smell; it is said to be composed of garlic, sagapenum, turpentine, and a small proportion of real assafætida. It is very brittle, and gives a large residue when treated with spirit of wine, whereas good assafætida leaves but about the fifth part of its weight of insoluble residue.

ATROPINE OR ATROPIA.

Belladonna, U. S.

This is the active principle of the *Atropa Belladonna* L. When perfectly pure, it is in the form of white, transparent prisms, having a silky lustre. It is inodorous, soluble in absolute alcohol and in sulphuric ether, both of which take up more when hot than when cold. Water, at the common temperature, dissolves about 1.500 of its weight. This solution has an unpleasant bitterness, and when applied to the eye dilates the pupil, quickly and durably. By simple contact with water and air, at the ordinary temperature, atropine loses its crystalline property; and the crystals already formed disappear. The liquor which results assumes a yellow colour, and leaves an uncrystallizable residue, soluble in all proportions in water. The atropine thus changed has a nauseous narcotic odour; it is equally poisonous as before, and when combined with an acid, and the solution treated with animal charcoal, the alkalies precipitate solid and crystallizable atropine. The aqueous solution of atropine gives an abundant white precipitate, with the infusion of gall-nuts. It gives a citron yellow precipitate with chloride of gold, and an Isabella yellow with the solution of chloride of platinum. According to Dumas, the solution of chloride of gold, slightly acid, is characteristic in its action upon a solution of atropine. The citron yellow precipitate, at the end of a certain time, assumes a crystalline structure, and consists of a compound of hydrochlorate of atropine and chloride of gold.—(*Chimie appliquée aux Arts.*)

BALSAM OF COPAIBA.

Copaiba, U. S.

This is the produce of several species of *Copaifera*, the chief supplies being drawn from the *C. Langsdorffii* Desf.

and the *C. Jaquini Desf.*; the former of which is a native of Brazil, and the latter of the West Indies. The best kind is said to be that which comes from Brazil. It is a clear, transparent liquid, of a pale yellow colour, of the consistence of olive oil, having a peculiar odour, and a hot, bitterish, nauseous taste. Its specific gravity is from 0.950 to 1,000. It is insoluble in water, but entirely soluble in absolute alcohol, ether, and the fixed and volatile oils.

Balsam of copaiba is often adulterated with castor oil, and the following tests have been proposed for the detection of its presence.

1st. By agitating the balsam with a solution of caustic soda, and setting it aside to repose; the balsam will at length float, clear, on the top, and leave a soapy, thick magna of the oil below. 2d. When the balsam is boiled with water, in a thin film, for some hours, it will become a brittle resin on cooling, but it will remain viscid, if mixed with castor oil. 3d. If a drop of the balsam on white paper be held over a lamp, at a proper distance, its volatile oil will evaporate and leave the brittle resin without causing a stain around, which the oil will produce. 4th. If the balsam be triturated with a little common magnesia alba, it will form a transparent solution, if it be pure; but will form a white liniment, if it contain castor oil. When balsam of copaiba is adulterated with oil of turpentine, the fraud is detected by the smell, on heating the mixture. It must be confessed, however, that these tests sometimes fail to detect the impurities of copaiba.

In proof of the adulterations which were practiced with balsam of copaiba, in England, when its price was high, Dr. Paris refers to a curious trial, which took place "between the owner of certain premises that were burnt down, and the governors of the Sun Fire Office, in consequence of the latter refusing to indemnify the proprietor for his loss, because the fire had been occasioned by the *making of balsam of copaiba*.—(*Burnett's Outlines of Botany.*) } (770

BALSAM OF PERU AND BALSAM OF TOLU.

Myroxylon, U. S.—*Balsamum Peruvianum*, L. and *Balsamum Tolutanum*, L.

These are resins obtained from the *Myroxylon peruiferum* and *M. toluifera* Kunth. (*Myrospermum peruiferum*, D. C. and *M. toluiferum* Rich.), trees of the warmer regions of South America, by making incisions into the bark. The resinous secretions which flow out are received in vessels of various kinds, in which they harden by exposure to the air.

These balsams are so similar that, in commerce, they are frequently confounded. The ordinary Balsam of Peru, which is liquid, and of a dark colour, is produced by boiling the small twigs of the *M. peruiferum* in water, and skimming off the supernatant balsam. Its taste is pungent, acrid and bitter. It should dissolve in rectified alcohol, and leave a very slight pulverulent residue. It is sometimes adulterated with a fixed oil, and sometimes with alcohol. The presence of the former can be detected by processes similar to those described under the preceding article. If mixed with spirit of wine, the liquid, when shaken with some water in a graduated glass tube, becomes milky, and after it has settled, and the oil and water have separated, the oil is found to have diminished in bulk, and the water to have increased. The loss of bulk of the oil indicates the extent of the adulteration.

Balsam of Tolu, when first imported, has a soft, tenacious consistence, but by age it becomes hard and brittle, like resin. It is of a reddish yellow colour, and has a fragrant odour. When pure, it is entirely dissolved by alcohol, and the essential oils. Boiling water extracts the benzoic and cinnamic acids which it contains.

BARIUM, CHLORIDE OF.

Barii Chloridum, U. S.

This salt crystallizes in the form of white, flat, four-sided tables, bevelled at the edges. It has a disagreeable, and slightly bitter taste, and undergoes little or no change in ordinary states of the air. When heated, the crystals decrepitate, lose their water of crystallization, and at a red heat, fuse. 100 parts of water dissolve about 43 of these crystals, at 60° F., and 78, at 222° F., which is the boiling point of the saturated solution. If nitrate of silver be added to a solution of the chloride of barium, it gives a white precipitate insoluble in nitric acid, but soluble in ammonia; all the soluble sulphates give with it a white precipitate of sulphate of baryta, insoluble in nitric acid. Alcohol, impregnated with this salt, burns with a yellow flame.

Pure chloride of barium must not affect vegetable colours, nor ought its solution to be altered by ammonia, which proves the absence of alumina, and oxide of iron; nor by sulphuretted hydrogen, nor by hydrosulphuret of ammonia, which shows that it contains neither lead nor copper. Pure sulphuric acid must precipitate every fixed particle from it, so that the filtered liquid leaves not the slightest residue when evaporated on platinum foil. If it contains lime or strontia, the filtered liquid will give a white precipitate, with carbonate of soda: in the former case more abundant than in the latter, from the greater solubility of the sulphate of lime. If any considerable portion of strontia is present, the alcoholic solution will burn with a red flame.

BARYTA, NITRATE OF.

This salt crystallizes in transparent octahedrons, which are not altered by exposure to the air. It is soluble in 12 times its weight of water at 60° F., and in three or four of

boiling water ; insoluble in alcohol. At a bright red heat, it decrepitates, is decomposed, and yields pure baryta.

The tests of its purity are the same as those of chloride of barium. Nitrate of silver must not render its solution turbid.

BEER.

This liquor has been subject to various adulterations, having for their object to economise the hops, by substituting for them cheaper vegetable matters, to give to the must a bitter taste, as the wood of box, the root of gentian and leaves of menyantes ; and, in England, it is said they employ, for the same purpose, a most deadly poison, viz. : strychnine. As a very minute proportion of this alkali gives an excessively bitter taste to a great quantity of liquid, the beer thus adulterated does not immediately produce serious disorders in the animal economy, but the constant use of such a drink must, at length, injuriously affect the health.

When beer is sour it is the practise to correct the acidity by the addition of chalk, potassa, magnesia, &c. In some cases also, this liquor contains the oxides of copper and of lead, derived from the vessels in which it has been manufactured or kept.

Beer of good quality should present the following characters, viz. :

1. It should be transparent, and not flocculent ; its taste should be slightly bitter, acid and alcoholic.

2. It should contain a sufficient quantity of carbonic acid to produce a brisk effervescence when it is drawn.

3. It should redden litmus paper ; but when it acts strongly upon this colour, and when it produces no froth on being drawn, it is a proof that the acetous fermentation has set in, and its taste is disagreeable.

4. Oxalate of ammonia, acetate of lead, and nitrate of baryta should produce only slight precipitates.

5. Chloride of platinum ought scarcely to trouble it, because it contains only a small quantity of salts with a base of potassa.

Various narcotic plants are said to be added to beer, to increase its effect upon the animal economy. Among these are, *Ledum palustre*, *Asarum Europeanum*, *Veratrum nigrum*, *Papaver somniferum*, *Hyoscyamus niger*, *Salvia sclarea*, &c. These produce a high degree of excitement, which is soon followed by indirect atony. The hop belongs, in some measure, also to this class; and the same is true of the *Lolium temulentum*. Beer is also sometimes adulterated with grains of paradise, Spanish pepper, coriander, nut-galls, juice of liquorice, treacle, and tobacco leaves.

Unfortunately we are not yet in possession of the means of accurately detecting these adulterations and slow poisons. We are not without hope, however, that some process may hereafter be devised.

To stop the fermentation of beer, a plate of tin is sometimes introduced into the liquor; an acetate and carbonate of tin are thus formed, which render the beer very dangerous.

It is said that salt is added to beer for the purpose of increasing the thirst of the consumers. This substance can be detected by nitrate of silver, which causes a precipitate of chloride of silver insoluble in water and in nitric acid, and which becomes black when exposed to the sun.—(*Garnier and Harel, Des Falsifications des Substances Alimentaires.*)

BENZOIC ACID.

Acidum Benzoicum, U. S.—*Flowers of Benzoin*.

This acid is obtained by sublimation from gum benzoin, a resinous exudation from the *Styrax Benzoin*, *Dryand.*, a native of Sumatra and Borneo. It occurs in white aci-

cular crystals, of a satiny appearance. When pure it is inodorous; it has a hot, sweetish, and very peculiar taste, and reddens litmus. It dissolves in 25 parts of boiling water, but requires 200 of cold water for its solution. It is soluble in twice its weight of alcohol, and this solution when evaporated gives the acid pure and in prismatic crystals. At 248° F. it fuses, and at 293° F. should volatilize without residue, otherwise it contains some impurity. The vapours are very irritating, and cough provoking. The solution of benzoic acid in water should give no precipitate with a solution of chloride of barium or it contains sulphuric acid, nor with solution of oxalate of ammonia, otherwise it contains lime.

The benzoic acid obtained by simple sublimation from gum benzoïn often has a very strong odour and an acrid taste, owing to the presence of an oily and volatile substance. This fact should not be overlooked in the employment of benzoic acid for medicinal purposes.—(*Dumas, Chimie appliquée aux Arts.*)

BENZOIN.

Benzoinum, U. S.

This is the resin from which benzoic acid is procured. It is brought to market in large masses of an amygdaloidal or motley appearance; its colour is pale brown with white spots. It is brittle, has a resinous aspect and fracture, and becomes very fragrant when warmed. Its specific gravity is from 1.063 to 1.092. When heated it exhales pungent fumes, which consist chiefly of benzoic acid. It is wholly soluble in alcohol except the impurities, and is precipitated from the solution by water. An article is sometimes met with, which is indistinctly mottled, has a dark colour, and abounds in impurities.

BISMUTH.

Bismuthum, U. S.

A metal having a white colour resembling antimony, but with a reddish tint. It is very brittle and may be easily reduced to powder; specific gravity, 9.83. At 480° F. it undergoes fusion; at a strong heat it volatilizes, may be distilled in close vessels, and is thus obtained in crystalline laminæ.

Commercial bismuth often contains an admixture of lead, iron, arsenic, &c. Dissolve the suspected metal in nitric acid, add a considerable quantity of water to throw down the subnitrate, and to the filtered solution add some dilute sulphuric acid. If lead is present, a white precipitate of sulphate of lead will be produced. The presence of iron may be shown by the red brown precipitate produced in this solution upon the addition of ammonia; and of copper, by the blue colour which it assumes when supersaturated with this alkali.

Arsenic, when mixed with bismuth, may be detected by the following process. To the filtered solution obtained after the affusion of the nitrate of bismuth with water, add excess of ammonia, and afterwards hydrosulphuret of ammonia in sufficient quantity, and digest with a gentle heat. If arsenic is present, the sulphuret thus formed will be dissolved by the ammonia, and may be separated by filtration. The filtered solution is then acidulated by muriatic acid, and digested at a gentle heat until it no longer smells of sulphuretted hydrogen; the dissolved sulphuret of arsenic then falls down in the form of a bright yellow precipitate. From this, metallic arsenic may be obtained by the process described under the article *Antimony*.

Bismuth sometimes contains a little silver, and hence the nitrate becomes grey or dingy coloured on exposure to the

light. This can be further determined by adding a little muriatic acid to the solution of bismuth in nitric acid, when, if silver is present, a white curdy precipitate will be formed, which, by exposure to light, becomes of a dark colour.

BISMUTH, SUBNITRATE OR TRISNITRATE OF.

Bismuthi Subnitratis, U. S.—*Pearl White*.

This is a pure white tasteless powder obtained by dissolving metallic bismuth in dilute nitric acid, then throwing the solution into a large quantity of water, washing the precipitate which subsides, and drying it at a gentle heat. At a red-heat this powder fuses into a brown liquid, and it forms, on cooling, a yellow vitreous mass.

The subnitrate of bismuth is often mixed with chalk and white lead. To detect these substances, dissolve the powder in nitric acid, and add sulphuric acid. If carbonate of lead is present a white precipitate of sulphate of lead will be produced. To another portion of the solution, previously treated with acetic acid and diluted with water, add hydrosulphuret of ammonia as long as any precipitation takes place. Separate the clear part by filtration, and test it by oxalate of ammonia. If a white precipitate is formed it is owing to the presence of lime.

Arsenic and silver, sometimes found in metallic bismuth, rarely occur in the subnitrate if properly prepared. The nitrate of silver resulting from the action of nitric acid, is soluble in water, while the arseniate of bismuth is entirely soluble in water and in nitric acid, and will, of course, remain behind when the solution of bismuth is thrown into water. When the nitrate of silver is present, however, it causes the pearl white to blacken when used as a cosmetic. To avoid this disagreeable result, Dumas recommends the addition of some drops of muriatic acid to the solution of nitrate of bismuth, which should then be decanted before it is decomposed by water.

BLEACHING POWDER.

Calx Chlorinata, U. S.—*Chloride of Lime*—*Hypochlorite of Lime*.

A dry, white powder, which smells faintly of chlorine, and has a strong taste. It dissolves partially in water, the solution possessing strong bleaching powers, and being gradually decomposed by exposure to the atmosphere. The dry powder is decomposed by heat, evolving first chlorine, and afterwards pure oxygen gas, while chloride of calcium remains.

A convenient process for estimating the value of this powder consists in ascertaining the bleaching power of the liquid produced by its solution in water. A blue liquor is prepared by dissolving indigo in concentrated sulphuric acid, and diluting the solution with 1,000 parts of water. A portion of the chloride of lime, to be estimated, is weighed and mixed with water. A given quantity of the clear solution which it produces is mixed with as much of the blue liquor as it can deprive of colour. The value of a given quantity of the blue liquor is previously determined by an experiment made with a good specimen of bleaching powder, and all subsequent experiments are compared with this standard.

This test has been objected to on account of the change which indigo undergoes by keeping; and another has been proposed, in which protosulphate of iron is employed, and which depends upon the fact, that protoxide of iron is converted into peroxide by the agency of chlorine, through the decomposition of water. To carry out this test, 78 grains of green sulphate of iron are dissolved in about two ounces of water, and acidulated by a few drops of sulphuric or muriatic acid; this quantity will require for peroxidation, exactly ten grains of chlorine. Fifty grains of the bleaching powder to be examined are next rubbed up with

a little tepid water, and the whole transferred to the alkali-meter, (see the article, POTASSA,) which is then filled up to O with water, after which the contents are well mixed by agitation. The liquid is next gradually poured into the solution of iron, with constant stirring, until the latter has become peroxidized, which may be known by a drop ceasing to give a deep blue precipitate with red ferricyanide of potassium. The number of grain-measures of the chloride solution employed may then be read off, and since these must contain ten grains of serviceable chlorine, the quantity of the latter in the 50 grains may be easily reckoned. Thus, suppose 72 such measures have been taken, then—

| | | | | | | |
|----------|---|---------------|----|----------|---|---------------|
| Measures | | Grs. Chlorine | | Measures | | Grs. Chlorine |
| 72 | : | 10 | :: | 100 | : | 13.89 |

The bleaching powder therefore contains 27.78 per cent. of chlorine.—(*Graham's Elements of Chemistry.*)

The most common impurities in bleaching powder are carbonate of lime, hydrate of lime, water and sand. It is not necessary, however, to point out the modes in which the presence of these substances can be detected, as the most certain test of the real value of the powder is to determine by one or other of the above processes the proportion of chlorine which it contains.

BORACIC ACID.

Homborg's Sedative Salt.

This substance, which is found native in the hot springs of Lipari, and in those of Tasso, in the Florentine territory, usually occurs in the form of small, white, pearly scales, without smell and nearly tasteless. It is soluble in about thirty parts of cold, and three of boiling, water; the latter solution deposits it in pearly scales as it cools. It is also soluble in alcohol, to the flame of which it communicates a yellowish-green colour. The aqueous solution reddens lit-

mus paper, but it tinges turmeric paper brown. Its purity can in general be determined by a close attention to the above characters.

BORAX.—See SODA, BIBORATE OF.

BROMINE.

Brominium, U. S.

A dark brownish-red liquid, of a hyacinthine tint, in thin strata. It has a disagreeable odour, somewhat resembling that of chlorine, and a powerful taste. It is very volatile, so that when a few drops of it are thrown into a bottle, beautiful red vapours soon fill the vessel. It stains the skin of a yellow colour, is soluble to a small extent in water, more so in alcohol, and still more so in ether. When mixed with a solution of starch, it produces an orange-yellow colour.

Bromine has recently been introduced into use in the Daguerreotype process ; it has also been recommended as a medicinal article. Its purity can be judged of by the above characters, but especially by its colour, odour and volatility.

BURGUNDY PITCH.

Pix Abietis, U. S.

This is the concreted juice of various species of *Pinus*, (*Abies*, *D. C.*.) found in Europe and Asia, as *P. Abiès* *L.*, and *P. Picea* *L.* It is solid, brittle, opaque, of a brownish-yellow colour, and gives an agreeable odour when burned. It softens and becomes adhesive at the temperature of the body.

Burgundy pitch is generally mixed with impurities, which render it necessary to melt and strain it before being used. A factitious article is made by melting together pitch, resin and turpentine, and agitating the mixture with water. Its odour is different from that of the genuine article.—(*U. S. Dispensatory.*)

CACAO AND CHOCOLATE.

The seeds of the *Theobroma Cacao*, L., a native of South America, are known by the name of *Cacao*. They are of a reddish brown colour, somewhat brilliant, very brittle, rich, unctuous, and agreeably bitter. They must not be mouldy, nor white, nor have a rancid or insipid taste. Small, very dark coloured, and very bitter or styptic nuts should be rejected.

Chocolate.

Cacao, when prepared, by being dried and powdered, and then mixed with annatto and certain spices, forms the delicious and nourishing food called *Chocolate*. "The facility with which it can be conveyed and prepared, when wanted to be eaten, makes chocolate a most valuable and favorite food for travellers. Humboldt says that it is chocolate and maize flour that have rendered accessible to man the stupendous table lands of the Andes, and enabled him to penetrate the vast uninhabited forests of central America."

Chocolate is now extensively manufactured in Europe and America, and there are probably few articles that are more largely adulterated. Wheat flour, the flour of potatoes, of beans, rice and peas, fat, the yolk of eggs, almonds, gum, soap, &c., are some of the substances employed for this purpose.

The most common adulteration of chocolate, however, consists in mixing it with fecula slightly torrefied. This fraud may be detected by treating the chocolate with forty or fifty times its weight of water, causing the water to boil and treating the filtered liquor with the alcoholic tincture of iodine. A yellowish brown colour is the result when the decoction is one of chocolate without fecula, whereas if the chocolate contains fecula it will give a blue colour more or less intense.

Sometimes the butter of cacao is removed from the chocolate by pressure and heat, and its place supplied by tallow, oil of sweet almonds, or by almonds themselves. Chocolate, thus adulterated, soon becomes rancid, by which the fraud may be detected.

Some specimens of chocolate have been found to contain, in addition to less injurious articles, sulphuret of mercury, sulphuret of mercury associated with the red oxide of mercury, the same sulphuret with the oxide of lead or minium and red ochre. These articles seem to be employed for the purpose of giving the chocolate a fine red colour which differs from that of the natural chocolate and of increasing its weight. One mode of detecting their presence consists in rasping the chocolate, and treating it with cold water in sufficient quantity, taking care to agitate the liquid constantly. The adulterated chocolate gives a very abundant deposit which is of a brick red colour; this deposit is scarcely observable, is longer in forming, and is of a dull fawn colour, in the pure chocolate.

It is stated by Cadet that chocolate contains iron and lime in notable quantity, the latter derived probably from the stones which are employed in grinding the cacao.—(*Garnier and Harel, Des Falsifications des Substances Alimentaires.*)

Dr. Ure states that some chocolate made at Deptford, for the use of the British Navy, and which had produced sickness and in a few cases even death, was upon examination found to consist of gritty grains, from very imperfect trituration or milling. These grains were quite immiscible with water, and contained many sharp spiculæ of the cacao-bean husks, and when swallowed, they were calculated to form mechanically irritating lodgements in the villous coats of the stomach and bowels. From the insoluble condition of the chocolate, moreover, it could be of little use as an article of food, or as a demulcent substitute for milk, and three-

fourths of it were on this account, an ineffective article of diet ; or were wasted.—(*Dictionary of Arts, &c., Suppl.*)

CAJEPUT OIL.

Cajeputi, L.

This oil is obtained by the distillation of the leaves of the *Melaleuca Leucadendron* L., a tree which grows in the Molucca Islands. It is very limpid, lighter than water, of a strong smell resembling camphor, and a pungent taste like cardamon. It often has a green colour from the copper flasks in which it is sent to market. When rectified it becomes colourless. Dr. Burnett states that during the prevalence of the cholera in London there was a great demand for this article on account of its reputed virtue in that disease. In consequence of this its price became exorbitantly advanced, and in an inverse ratio its quality diminished. Much that was sold under the name of cajeput oil did not contain even a drop of the veritable drug.—(*Outlines of Botany.*) 2, 7/2 (17, 5)

CALCIUM, CHLORIDE OF.

Calcii Chloridum, L.

It commonly forms a white mass, but can be procured in large transparent crystals. It deliquesces very rapidly in the air and easily dissolves both in water and in alcohol. It gives a white precipitate on the addition of a solution of oxalic acid or oxalate of ammonia, and also causes a white precipitate, insoluble in nitric acid, but soluble in ammonia, by solution of nitrate of silver. Its solution must be colourless and perfectly neutral. It must give no precipitate with pure caustic ammonia, otherwise it contains magnesia. A reddish precipitate with this reagent indicates iron ; a white one, alumina. It should not evolve ammonia when mixed

with potassa or hydrate of lime, nor give a precipitate with chloride of barium.

CAMPHOR.

Camphora, U. S.

An inflammable substance closely resembling the essential oils. There are two kinds of camphor: that of Japan or *common camphor*, obtained from the *Laurus camphora* L.; and that of Borneo, *Borneo camphor*, the produce of the *Dryobalanops aromatica*, Gaertner.—(*D. Camphora*, Colebrooke.) The latter is said to be so highly prized by the Japanese, that it is not found in the markets of Europe. It occurs in small crystalline fragments, and its odour is distinctly alliaceous. The common camphor, in its ordinary state, is in white, translucent, semi-crystalline masses, which are tough, but easily pulverized when moistened with alcohol. Its specific gravity is from 0.985° to 0.997. It fuses at 347° F., and boils at about 400° F. In close vessels it may be sublimed unchanged. It readily takes fire and burns with a brilliant flame, giving out much smoke, and leaving no residue. It is insoluble in water, but freely soluble in alcohol. The best tests of its purity, are its complete solubility in alcohol, and its combustion without residue.

CANELLA ALBA.

Canella, U. S.

This is the bark of the *Canella alba*, Murr., (*Winterana Canella* L.,) a native of the Caribbean Islands, and of the warmer parts of South America. It is imported in long quill-like pieces, of a yellowish grey colour, has an agreeable aromatic odour, resembling that of cloves or coriander, and a warm, pungent and somewhat bitter taste. It gives a yellow powder, and its virtues are partially extracted by water, and entirely by alcohol.

Canella is sometimes confounded with Winter's bark, from which it differs both in sensible properties and in composition.

CANNA STARCH.

This is a variety of starch recently introduced into the markets of Europe and America. It is known in France by the name of *Tous les Mois*. It is said to be prepared in the Island of St. Kitts, from the root of the *Canna coccinea*.

This variety of starch is in the form of a light, beautifully white powder, having a shining appearance, unlike the common forms of that substance. Its granules are said to be larger than those of any other variety, are ovate or oblong, with numerous regular, unequally distant rings, and a circular hilum situated at the smaller extremity. It has the chemical properties of starch, and forms a stiff nutritious jelly with boiling water.—(*U. S. Dispensatory*.)

CANTHARIDES.

Cantharis, U. S.—*Blister Beetle*, or *Spanish Fly*.

This is an insect, the *Cantharis Vesicatoria*, *Latreille*, found in the southern and temperate parts of Europe, and in the west of Asia. It is from six to ten lines in length, by two or three in breadth, and of a beautiful shining golden green colour. The head is large, and heart-shaped, bearing two thread-like, black, jointed feelers; the thorax short and quadrilateral; the wing-sheaths long and flexible, covering brownish membranous wings. In the dry state, Spanish flies have a burning, acrid and urinous taste. Their powder is of a greyish brown colour, interspersed with shining particles. If kept perfectly dry, in a well closed vessel, they retain their activity for a long time; but if exposed to damp air, they quickly undergo putrefaction, especially if in powder. They are liable, however, to the attack of mites, which greatly impairs their vesicating properties.

Spanish flies are sometimes mixed with other insects, either purposely, or through carelessness. A careful inspection will generally detect this adulteration. Pereira states that powdered flies are sometimes adulterated with euphorbium. Cantharides should never be purchased in powder, as in this state they are more liable to injury, as well as more easily adulterated.

CAPSICUM.—See CAYENNE PEPPER.

CARAWAY SEEDS.

Carum, U. S.

These are the seeds of the *Carum Carui* L., found in all parts of Europe. Those which are the growth of England are said to be the best, at least by the English authors. The seeds are ovate-oblong, and striated; odour, aromatic; taste, warm and grateful. The Dutch seeds are sometimes musty and insipid.

CARBONIC ACID WATER.

Aqua Acidi Carbonici, U. S.

This is water charged with several times its bulk of carbonic acid, and the only point to be determined is the purity of the water employed. The large excess of carbonic acid renders various substances soluble which will be precipitated on allowing the gas to escape.

CARDAMON SEEDS.

Cardamomum, U. S.

These are the seeds of the *Alpinia Cardamomum* Roxb., a native of Malabar. They are angular, irregular, rough, of a brown colour, and easily reduced to powder. They have a fragrant odour, a warm and highly aromatic taste. These properties are extracted by water, and by alcohol, but more readily by the latter.

Cardamon seeds are imported in their pods, and three varieties of these are found in British commerce : 1. the *shorts*, from three to six lines long, from two to three broad, browner and more coarsely ribbed, and more highly esteemed than the other varieties ; 2. the *long-longs*, from seven lines to an inch in length, by two or three lines in breadth, elongated, and somewhat acuminate ; and 3. *short-longs*, which differ from the second variety in being somewhat shorter and less pointed.—(*Pereira's Materia Medica.*)

The seeds are best preserved in their capsules, and should be powdered only when wanted for immediate use.

CARMINE.

Carmine, according to Pelletier and Caventou, is a triple compound of the colouring substance, and an animal matter contained in cochineal, combined with an acid added to effect the precipitation. There are several kinds in market, distinguished by numbers and possessed of a corresponding value. This difference depends either upon the proportion of alumina added in the precipitation, or of a certain quantity of vermilion put in to dilute the colour. In the first case, the shade is paler ; in the second, it has not the same lustre. These adulterations may be detected by the employment of water of ammonia in which carmine is soluble ; the foreign matter remains untouched, and its amount may be determined by drying the residue. Sometimes carmine is adulterated with red lead. This may be detected by digesting it in nitric acid, diluting the solution, and causing a stream of sulphuretted hydrogen to pass through it, when, if lead is present, a black precipitate of sulphuret of lead will be formed. When adulterated with starch, as it sometimes is, solution of ammonia enables us to detect the fraud, in consequence of the solubility of pure carmine in that alkali. The presence of the starch may be afterwards determined by tincture of iodine.

CASTOR.

Castoreum, L.

This is the name given to a secretion of the *Castor fiber* L., or beaver, an amphibious quadruped, inhabiting the northern parts of Europe, Asia and America. It is contained in pear-shaped sacks or bags placed near the genital organs. It has a bitter taste, a reddish colour, and a powerfully fetid smell; but when dried, it becomes inodorous. The castor bags, as they usually occur, are joined in pairs. Sometimes a portion of the castoreum is extracted and replaced by lead, clay, gums and other foreign matters. This fraud may be easily detected, even when it exists in a small degree, by the absence of the membranous partition in the interior of the bags, as well as by the altered smell and taste.

This drug is distinguished, according to its source, into the Canadian or American and the Russian castors. The former is considered the most valuable, but our market is supplied chiefly by the latter. It is said that the Canadian castor, treated with distilled water and ammonia, affords an orange precipitate, while the matter thrown down from the Russian is white.

CASTOR OIL.

Oleum Ricini, U. S.

This is the produce of the seeds of the *Ricinus Communis* L., a native of the East Indies; but which is extensively cultivated in Europe and America. It has a pale yellow colour, and a slightly nauseous odour and taste. That which is *cold drawn* by pressure is less acrid and purgative than the West India castor oil, formerly preferred for medical use, and which was often pressed with heat and even boiled

out of the seeds. Specific gravity at 55° F. 0.969. It congeals at about 0°. Exposed to air it gradually becomes rancid, thick, and at length congeals. It dissolves completely in alcohol of the specific gravity of 0.820. If it forms a milky mixture, or if any portion remains undissolved, it is probably adulterated with some of the more common oils. Castor oil which has become rancid, is excessively acrid, and should not be used medicinally. It is then poisonous, even though taken in small quantities. —(*Dumas, Chimie appliquée aux Arts.*)

CATECHU.

Catechu, U. S.—*Terra Japonica*—*Cutch*.

An extract made from the wood of the *Acacia Catechu Willd.*, a native of the East Indies; of the *Uncaria Gambir Roxb.*, a native of many of the islands of the Indian Archipelago; and other species. It is prepared by boiling the chips of the interior of the trunk in water, until the decoction is sufficiently concentrated to become on cooling a tough extract; it is then divided into small masses and slowly dried by exposure to the air.

Several varieties of catechu occur in commerce, but those most commonly met with in the druggists' shops, are the *pale catechu* and the *brown catechu*. The former is obtained from the *Uncaria Gambir*. It occurs in cubes whose faces are about an inch square; it has a yellowish brown colour, but paler internally; it is without odour, but has an astringent taste, becoming feebly sweetish. The brown catechu is the produce of the *Acacia catechu*. It occurs in irregular masses of a chocolate brown colour, very friable, with an astringent bitter taste.

When of good quality, catechu is almost entirely soluble in alcohol, but it often contains earthy matters which resist solution. The best test of the value of any variety is to de-

termine the amount of tannin which it contains. Probably the best process for this purpose is to add solution of gelatin to a solution of the catechu in water. The tannogelatin which results, when dried, at 212° F., consists of about 54 tannin and 46 gelatin.

CAYENNE PEPPER.

Capsicum, U. S.

The powder known by this name is the produce of several species of *Capsicum*, as *C. annuum* L., *C. baccatum* L., &c. It has a more or less bright red colour, a pungent, aromatic odour, and a very biting, hot and aromatic taste. It is often mixed with variable proportions of common salt. The salt may be separated by dissolving the pepper in water, filtering, and slowly evaporating the filtered solution at a moderate heat. Or its presence and proportion may be determined by adding to a filtered solution of a weighed portion of the pepper, a solution of nitrate of silver as long as it causes a precipitate, and then filtering, washing, drying and weighing the precipitated chloride of silver.

Cayenne pepper is sometimes adulterated with coloured saw-dust. It is also often mixed with red lead, to prevent it losing its colour on exposure to light. The latter impurity can be detected by solution in nitric acid, and precipitation of the black sulphuret of lead by a stream of sulphuretted hydrogen, or by the formation of a white precipitate of sulphate of lead upon the addition of sulphate of soda to the clear solution in nitric acid.

CERA FLAVA.—See WAX.

CHARCOAL.

Carbo Ligni, U. S.

An article of prime importance as a fuel, prepared by burying in sand, or in earth, pieces of wood, and burn-

ing them with a limited supply of atmospheric air. The process is often very carelessly conducted, and the consequence is a great reduction in the value of the charcoal. The different kinds of wood furnish variable quantities of charcoal. That which is obtained from the hard woods is most highly esteemed. Its value may, therefore, be determined by ascertaining its density.

When used in the laboratory, or in pharmacy, charcoal should be recently prepared. If it cannot be had fresh made, it must be heated to redness under sand in a crucible, in order to drive out the moisture and gases which it has absorbed and condensed.

If charcoal powder is ever employed as a dentrifice, it should also be recently prepared, powdered with the utmost despatch in a hot metallic mortar, and speedily introduced into a phial, which should be well corked, and even sealed. When this powder is used, it ought to be exposed to the air as short a time as possible. What is sold in boxes is totally useless for the purpose of correcting fætor, the only object for which charcoal should ever be employed as a dentrifice.

CHARCOAL, ANIMAL.

Carbo Animalis, U. S.—*Ivory Black*.

This is obtained by the carbonization of animal substances, such as muscle, horns, or hoofs. When pure, it is a dark, brownish black powder, having a peculiar lustre. It should not be acted on by muriatic acid. If the charcoal contains carbonate of lime, it will effervesce upon the addition of this acid, and the clear solution will give a white precipitate with carbonate of ammonia. If phosphate of lime is present, it will also be dissolved by muriatic acid, and yield a precipitate upon the addition of ammonia. This will explain the reason why when purified animal charcoal is required, the bone black is to be washed with muriatic acid, continued as

long as the washings give a white precipitate with ammonia. It should then be washed with pure water until the liquid does not change the colour of litmus. According to the Edinburgh College, purified animal charcoal, when incinerated with its own volume of red oxide of mercury, is dissipated, leaving only a scanty ash.

The charcoal obtained by charring bones, and known in commerce by the name of *Ivory black*, is mixed with the phosphate and carbonate of lime. For decolourizing operations the presence of these bodies does no injury. It is said, however, that when the charcoal has been too much or too little calcined, it is much less active than when the calcination has been just carried to the point at which all the animal matter is destroyed.

CIDER.

There are various substances which are added to cider to heighten its colour, and to make it appear stronger than it really is ; such as the flowers of the false poppy, elder-berries, cochineal, &c. The addition of these substances is seldom attended with any injurious consequences, and their presence can, to a certain extent, be determined by the modes pointed out under the article WINE.

Brandy is sometimes added to cider, for the purpose of giving it more strength. This may be recognized by the odour and taste which brandy communicates to the liquid. It has been thought that cider mixed with brandy could be easily distinguished from that which does not contain it, by the property which it possesses of giving out its alcohol at the gentle heat of the water bath, while the natural cider loses its alcohol only when it is raised to the boiling point. But this test is of no value, inasmuch as the alcohol can be separated from ordinary cider by heating it in a water-bath to 150° or 160° F.

Lime, chalk or ashes are sometimes added to cider, to

heighten the colour, and to saturate the acetic acid which is always formed when the cider has been for some time on draught. The presence of lime may be detected by the addition of oxalate of ammonia, which, although it occasions a slight disturbance in pure cider, on account of a minute quantity of calcareous salts which it contains, does not produce that abundant precipitate which is caused by this reagent when the lime has been added for the purpose of saturating the acetic acid. The presence of potassa may be shown by the employment of the chloride of platinum, which occasions an abundant precipitate. As cider in its natural state contains only a very minute proportion of potassa salts, it is scarcely troubled by the addition of this test.

Various preparations of lead, such as white lead, litharge, &c., are employed to saturate the excess of acetic acid, and to correct the disagreeable taste of cider. A portion of lead is also sometimes derived from the presses and troughs employed in the manufacture. In some countries this practice has been followed to a great extent. The presence of lead in any of its forms of combination can be detected by the process indicated under the article WINE.

CINCHONA.—*See* QUININE.

CINNAMON.

Cinnamomum, U. S.

The cinnamons and cassias of commerce are the bark of various species of *Laurus L.*, (*Cinnamomum Nees*,) of which the most esteemed is the inner bark of the *Laurus Cinnamomum L.*, a native of Ceylon, but which is also cultivated in the Cape de Verds, Brazil, the West India Islands, &c.

The best cinnamon is in long cylindrical bundles composed of numerous quills, the larger enclosing the smaller. These quills are of a light brownish yellow colour, almost as thin as paper, smooth, somewhat pliable, have a fragrant odour,

and a warm, aromatic, sweetish and slightly astringent taste. It is said to be often adulterated with cassia bark, or with cinnamon bark, from which the essential oil has been separated by distillation.

The goodness of cinnamon can be judged of by the above characters, and especially by its taste. The inferior kinds are browner, thicker, less splintery, and have a less agreeable flavour.

Under the name of *Cassia* various inferior kinds of cinnamon are found in market. These varieties are usually in single tubes, much thicker, rougher and denser than the Ceylon cinnamon. They have also a darker colour, a stronger, more pungent and astringent, but less pleasant taste. It is said, also, that by infusion cassia imparts a yellow colour to alcohol, whereas cinnamon produces a much fainter coloured solution.

The genuine *Oil of Cinnamon* is exceedingly hot, sweet and aromatic, but its flavour, when diluted, is very rich and agreeable, and very different from that of oil of cassia, which is sometimes substituted for it, and with which it is occasionally adulterated. It sinks in water.

CITRIC ACID.

Acidum Citricum, U. S.

This acid is contained in large quantity in the juice of the lime and lemon, *Citrus Medica L.* It occurs in large and transparent crystals, the primary form of which is a right rhombic prism, if the process of evaporation has been conducted slowly; but if the solution is evaporated at 212° F., the form is different, and two atoms of water are removed. In the former state, it is soluble in an equal weight of cold, and about half its weight of boiling, water. The solution is strongly acid, and becomes mouldy by keeping. When added in excess to lime water, no precipitate is produced.

It does not yield a crystalline precipitate when added in excess to a solution of carbonate of potassa. It forms with barytic water a white precipitate of citrate of baryta, and with solution of acetate of lead a white precipitate of citrate of lead, soluble in ammonia.

Citric acid is liable to be adulterated with tartaric acid ; and very often tartaric acid is substituted in bulk for citric acid. Large crystals of oxalic acid also have been occasionally found among the crystals of citric acid. To detect the presence of tartaric acid, dissolve the suspected citric acid in a small quantity of water, and add to the solution some potassa, which will occasion a white crystalline precipitate of cream of tartar. Excess of lime water also when added to the solution of suspected citric acid, will cause a precipitate, *in the cold*, if tartaric acid is present. This precipitate is readily soluble in cold potassa, the solution forming a gelatinous precipitate on boiling, which disappears again on cooling. To detect oxalic acid, add to a similar solution of the suspected citric acid a solution of sulphate of lime ; if any oxalic acid is present, a white precipitate of oxalate of lime will be formed.

If the presence of lime is suspected in the citric acid, dissolve the acid in water, neutralize the solution with ammonia, and add a solution of oxalate of ammonia ; if lime be present, it will produce a white precipitate of oxalate of lime.

Crystallized citric acid is sometimes found to attract the moisture of the atmosphere. This may be owing to its containing a portion of sulphuric acid. To determine this fact, dissolve the citric acid in water, and add to the solution a few drops of a solution of chloride of barium. If this causes a white precipitate, insoluble in muriatic acid on being gently heated, it is due to the presence of sulphuric acid.

CLOVES.

Caryophyllus, U. S.

The unexpanded flower buds of the *Caryophyllus aromaticus* L., a tree which is a native of the Moluccas, and of other islands in the Chinese Sea, but which is cultivated in India, China, Persia, Arabia, &c. They have a strong aromatic and peculiar odour, an acrid and pungent taste. They resemble a small nail with a toothed head; colour deep brown. At one time the fraud was common of extracting part of the oil from the cloves, and then sending them into market with various quantities of the uninjured spice. The cloves which have been subjected to distillation are lighter than those which are good, shrivelled, of a paler colour, and give out no oil when compressed by the finger nail. Cloves are remarkable for their power of absorbing moisture, and cunning traders put the bulk of spice, when any quantity is ordered, near a vessel of water, and as they are sold by weight, a very considerable addition is made surreptitiously to the actual quantity of the spice. The clove tree, when growing, absorbs moisture most greedily, both from the soil and atmosphere; even to such an extent, that it is said no herbage is found beneath its shade.—(*Burnett's Outlines of Botany.*)

COAL GAS.

This gas when first made contains a great number of other substances in small quantities. Several of these are separated by the lime water employed in the process. If the odour of sulphuretted hydrogen is observed, it may be inferred that the quantity of lime is insufficient for the purification of the gas. Naphtha vapour, which exists in a very minute quantity, is the principal cause of the peculiar odour of coal gas, and the sulphuret of carbon, causes it to blacken

lead and silver, and gives sulphurous acid when burned. The specific gravity of the purified gas varies from 0.450 to 0.700. The relative value of a specimen of coal gas, as compared with any other substance employed for a similar purpose, may be determined by comparing the illuminating power, and the cost of each per hour.

COBALT.

This metal is difficultly reduced from its ores, and has not been hitherto employed in the arts. The metal often sold by that name in the shops is arsenic, which may be proved by throwing a small fragment of it on hot coals, when the garlic odour will be instantly perceived.

COBALT, OXIDE OF.

This oxide, in its pure form, is of an ash grey colour. It is soluble in acids, and when recently precipitated almost entirely soluble in excess of ammonia. The *Zaffre* of commerce is prepared by calcining the ores of cobalt, by which the sulphur and arsenic are volatilized, and an impure oxide of cobalt remains, which is mixed with about twice its weight of finely-powdered flints. *Smalt* and *Azure Blue* are made by fusing zaffre with glass. A blue glass is thus formed, which, while hot, is dropped into water, and afterwards reduced to a very fine powder.

The oxide of cobalt is sometimes contaminated with iron, copper, arsenic, antimony and bismuth.

COCCULUS INDICUS.

The drug known by this name consists of the fruit of the *Cocculus suberosus* D. C., (*Menispermum Cocculus* L.) a large tree which grows upon the coasts of Malabar, Ceylon, &c. It is very poisonous, and is often employed to destroy vermin, and to intoxicate or poison fish. It is largely imported

both into England and into the United States, and is said to be used to adulterate fermented liquors, and to increase the intoxicating property of beer. The fruit is about the size of a large pea, dark brown and wrinkled, within which is a bivalved, one-celled shell; the kernel is white and oily, and does not completely fill the shell. It is without odour, but has an intensely bitter taste. Its narcotic and poisonous properties are due to a vegeto-alkaline principle, which has been called *Picrotoxine*.

As met with in commerce, the kernel of the *Cocculus Indicus* is often completely dried up, so as to leave the shell nearly if not quite empty. The Edinburgh College directs "that the kernels should fill at least two-thirds of the fruit."

COCHINEAL.

Cocci, U. S.

The article known in commerce by the name of *Cochineal*, is the dried body of an insect, the female of the *Coccus Cacti* L., found in Mexico.

The fine cochineal, when well dried and preserved, should have a grey colour, bordering on purple. It is wrinkled with parallel furrows across its back, which are intersected in the middle by a longitudinal one; hence when viewed by a magnifier, especially after being swollen by soaking for a little while in water, it is easily distinguished from the factitious, smooth, glistening, black grains, of no value, called East India Cochineal, with which, according to Dr. Ure, it is often shamefully adulterated by certain London merchants. The genuine cochineal has the shape of an egg bisected through its long axis, or of a tortoise, being rounded like a shield upon the back, flat upon the belly, and without wings. The principal sorts of cochineal are the *silvery*, being of an ash-grey colour, and the *black*; the latter being most highly esteemed.

Dr. Ure states that the adulteration of cochineal has for many years been practiced upon a prodigious scale by a mercantile house in London. The genuine article is moistened with gum water, agitated in a box or leather bag, first with sulphate of baryta in fine powder, afterwards with bone or ivory black, to give it the appearance of black cochineal, and then dried. The specific gravity of genuine cochineal is 1.25 ; that of the cochineal loaded with the barytic sulphate 1.35.—(*Dictionary of Arts, &c.*) If this adulterated cochineal is macerated in warm water, the powder separates and falls to the bottom of the vessel. Cochineal is sometimes also manufactured by mixing dust and refuse of cochineal with water and mucilage into a paste, which is afterwards granulated to the size of the dried insect. This sort of cochineal falls to pieces when put into water, which is not the case with the real cochineal.

As the value of cochineal depends upon its colouring power, one of the most exact methods of determining it is that recommended by Robiquet: Take a certain weight of cochineal, of good quality, and the same weight of the cochineal which is to be tried. Boil each in an equal quantity of water, and put an equal quantity of each solution into two little graduated glass tubes. Add to each, a little at a time, a solution of chlorine gas in water, until the two red liquors are rendered yellow. The different quantity of chlorine liquor required for the bleaching of each cochineal liquor, serves to point out the relative strength or colouring power of the two liquors ; that which requires the most chlorine to bleach it being, of course, the one which contains the most colour.

Cochineal should be kept in a dry place.

COFFEE.

It is well known that coffee, when sold in powder, is adulterated with various torrefied substances ; such as the

roots of the chicory, of the beet, the carrot, and with peas, beans, rye, &c. Most commonly, however, torrefied chicory is preferred, and a powder is sold in France by the name of *Chicory coffee* and *Mocha coffee*.

It is quite easy to determine by the taste whether chicory has been mixed with coffee. But there are other modes of detecting this adulteration. In rolling between the index finger and the thumb a mixture of coffee and chicory, after having moistened it, we obtain a small ball; pure coffee remains in powder. Or we fill a glass with water, and throw into it some ground coffee. The coffee is pure when nothing falls to the bottom, for the chicory immediately absorbs, the water, falls to the bottom of the vessel and gives the liquid a yellow colour. This test depends upon the fact that the two substances absorb water in different periods of time, the coffee being less permeable on account of the oil which it contains.

Ground and burnt coffee is also adulterated with burnt rye. This mixture can be detected by passing the infusion of the coffee through animal charcoal to deprive it of its colour and then adding to the filtered solution the tincture of iodine. A blue colour will appear if rye is present, from the action of the starch which it contains.

Adulteration of Chicory.—It is now ascertained that in France, even chicory, the price of which is so low, is adulterated with articles still cheaper. Among these may be enumerated roasted bread, roasted barley, animal charcoal which has been used in sugar refineries, and the dregs of coffee. The two former may be detected by adding to the filtered and clarified decoction, some tincture of iodine, which will produce a blue precipitate, while no such change will follow if the chicory is pure. The powder of chicory, moreover, when thrown into water instantly falls to the bottom, which is not the case with the mixed powder. Animal charcoal exhibits black brilliant points, and renders

the mixture inodorous. Upon adding to it repeated portions of boiling water and pouring off from time to time the light matters held in suspension, the black powder remains at the bottom and after calcination its weight may be determined. The presence of coffee-grounds may be detected by drying the mixture and then throwing it into a glass of water; the coffee-grounds remain on the surface of the water for a certain length of time.

COLCHICUM.

Colchici Radix, U. S.

This is the bulb or cormus of the *Colchicum Autumnale* L., sometimes called *Meadow Saffron*, a native of the temperate parts of Europe. In its recent state it resembles the bulb of a tulip. It is covered externally with a brown membranous coat; internally it is solid, white and fleshy. In the shops it usually occurs in dried, transverse, circular slices, about the eighth or tenth of an inch in thickness, with a notch at one part of the circumference. These pieces have a white surface, are inodorous, but have a bitter, hot and acrid taste.

The active properties of the *Colchicum* are supposed to be due to a peculiar principle which has been called *Colchicine*, and which seems to be entirely extracted by wine and vinegar. Dr. A. T. Thomson states that the milky juice of the fresh bulb produces a beautiful cerulean blue colour if rubbed with the alcoholic solution of guaiac; and that the same effect is obtained by substituting for the juice an acetic solution of the dried bulb. He considers the appearance of this colour, when the slices are rubbed with a little distilled vinegar and tincture of guaiac, as a proof that the drug is good, and has been well dried. A very deep or large notch in the circumference of the slices is considered by the same author an unfavourable sign, as it indicates that the bulb has been somewhat exhausted in the nourishment of the offset. The decoction yields a deep blue precipitate with tincture

of iodine, white precipitates with the acetates of lead, nitrate of protoxide of mercury, and nitrate of silver, and a slight precipitate with tincture of galls.—(*U. S. Dispensatory.*)

COLOCYNTH.

Colocynthis, U. S.—*Bitter Cucumber.*

This is the fruit of the *Cucumis Colocynthis* L., a native of several parts of Asia and Africa, and cultivated in Greece and Spain. The peeled fruit, which is the part used in medicine, is globular, has a spongy appearance, a white colour, a tough consistence, and an extremely bitter taste. When it is of a greyish or brownish colour, it is of inferior quality.

The compound extract of Colocynth, which is a highly valued preparation of this article, is often adulterated by the use of impure scammony. The substances thus introduced are principally chalk and starch. The former may be detected by the effervescence of the compound extract in dilute muriatic acid, and the white precipitate caused in this muriatic solution on the addition of oxalate of ammonia. If the filtered decoction, slightly acidified, becomes blue or purplish on the addition of tincture of iodine, we may infer the presence of some starchy substance.

COLCOTHAR.

An old name for the red oxide of iron. It is a brown red powder, which is obtained in its purest state by calcining dried sulphate of iron in a furnace till all the acid is expelled, levigating, elutriating and drying the residue. It is much used for giving the finishing lustre to instruments made of steel, &c. Much of the Colcothar in market is made from the copperas and alum sediments, and is greatly inferior to that prepared according to the former mode.—(See IRON.)

COLOMBA ROOT.

Colomba, U. S.

The root of the *Cocculus palmatus* D. C. (*Menispermum palmatum* Lam.), a native of Southern Africa. It is generally found in the shops in dried cylindrical slices, which have a thick yellow bark covered with an olive-coloured skin, and a browner and spongy central portion. It is usually much worm eaten, and for use those pieces should be selected which are the least so. It ought to have a bright colour. It is sometimes mixed with slices of bryony root, *Bryonia dioica*, a most dangerous adulteration, consisting in the substitution of a drastic purgative for a grateful tonic. The fraud probably originated in a belief which once prevailed that colomba was the root of the *Bryonia epigæa* W. which is said to resemble it in its properties.—(*Burnett's Outlines of Botany.*) 2, 73 (1845)

Colomba, when moistened and touched with tincture of iodine, should become blackish in consequence of the presence of starch. False colomba presents no change of colour when treated in this manner. Pure colomba gives no colour to sulphuric ether; false colomba gives it a fine yellow.

The root of the American columba, *Frasera Walteri* Mich., is said to have been sold in some parts of Europe for the genuine, and perhaps the same thing has been done in this country. According to M. Stolze of Halle, it appears that while the tincture of columba remains unaffected by the sulphate or sesquichloride of iron and gives a dirty grey precipitate with tincture of galls, the tincture of fraseria acquires a dark green with the former reagent, and is not affected by the latter.

COMMON SALT.

In France where there is a high duty upon this important article, there are numerous adulterations of it which are never practiced in this country. Among these may be mentioned the moistening of the salt to increase its weight, the addition of saltpetre, the soda of varech, sulphate of soda, plaster of Paris, alum and earthy matters.

In this country the impurities which are found in salt arise chiefly from carelessness in its manufacture. Some of these I shall briefly notice.

The presence of water.—Several specimens of Onondaga salt which I have examined were moist, and were found to contain from 5 to 12 per cent. of water. This is not owing to the fraudulent addition of a certain quantity of water, but to the want of attention in the drainage of the salt after it has been removed from the kettles in which the manufacture has been conducted. The Onondaga brine contains, in addition to common salt, notable proportions of the chlorides of calcium and magnesium. These being much more soluble than chloride of sodium must be removed by long drainage and by washing with saturated brine. If mixed with the salt their deliquescent property will cause the absorption of moisture from the air and thus the whole mass will become moist and increase considerably in its weight.

I have repeatedly urged this subject upon the attention of the manufacturers of salt in Onondaga county as one of the greatest importance. It is through a want of attention to the removal of these deliquescent chlorides, that much of the prejudice which has been excited against this salt is to be ascribed. There is less excuse for this because the objection may be obviated and the perfect purity of the salt secured, so far at least as these substances are concerned,

by the simple mode of washing the product, while in the process of drainage, by a saturated brine. By this means these soluble chlorides will be dissolved, while the common salt suffers but a trifling loss ; and the whole amount which has been removed may again be recovered by the evaporation of the brine employed in this washing.

The presence of the deliquescent chlorides may sometimes be detected by the bitter taste which they give to the salt. This fact can also be determined by weighing a certain quantity of salt that has been dried in a sand bath at a moderate heat, and then ascertaining the increase of weight which takes place by exposing it to the air for twelve or fifteen hours. The larger the proportion of these earthy chlorides the greater will be the increase in weight.

Carbonate and Sulphate of Lime.—These substances are sometimes added to common salt for fraudulent purposes. It is said that in France plaster of Paris is reduced to a fine powder, and has been offered for sale under the name of “*a powder to mix with salt.*”—(*Garnier and Harel.*)

Plaster gives salt a very white appearance, and is often on this account added to table salt. This practice is, I think, pursued to some extent at the salt works in Western New York. Sulphate of lime is, moreover, one of the constituents of all the western brines ; and the almost universal employment of lime at these works to promote the precipitation of the sparingly soluble substances, introduces into the salt a greater or less proportion of carbonate of lime, depending upon the care which has been exercised in the removal of the lime.

The presence and amount of carbonate of lime can be determined by dissolving a known quantity of the salt in water, with the aid of heat, throwing the solution upon a filter, and washing the insoluble residue with a sufficient quantity of water to ensure the solution of the sulphate of

lime. The carbonate of lime will remain on the filter, and may be separated from silica or other insoluble matters by dilute muriatic acid and subsequent filtration. The presence of the carbonate is proved by the effervescence caused by the muriatic acid and by the white precipitate produced by the saturation of the clear muriatic solution with ammonia and the subsequent addition of oxalate of ammonia.

If sulphate of lime is mixed with the salt, chloride of barium added to a portion of the solution filtered from the carbonate of lime, will give a white precipitate of sulphate of baryta; while oxalate of ammonia, added to another portion of the same solution, will cause a white precipitate of the oxalate of lime. By dividing such a solution into equal parts, and carefully washing, drying, igniting and weighing the precipitates, the proportion of sulphate of lime may be determined, if the absence of any other sulphate has been previously ascertained.

CONFECTIONARY.

The various articles of confectionary are sometimes coloured with poisonous mineral or organic substances. These frauds are the more dangerous because the great consumption of confectionary is by children and young persons. Among the colouring matters thus employed, may be mentioned chrome yellow, gamboge, Scheele's green, Schweinfurt green, minium and vermillion.

Detection of Injurious Colouring Matters.—All the above preparations are insoluble in water, except gamboge which is partly soluble; and they can be separated by putting a certain quantity of the confectionary into cold water, by which the sugar and the various extractive matters forming the basis of the confectionary will be dissolved, while the insoluble colouring matters will remain at the bottom of the vessel. They may then be separated by decantation or

otherwise, washed repeatedly with pure water, and dried in a small capsule at a gentle heat.

Chrome yellow, or chromate of lead, may be detected as follows :

Calcined with a little soda upon charcoal, a globule of metallic lead is obtained.

When boiled with a solution of carbonate of potassa, it is decomposed with the formation of chromate of potassa. This solution has a lemon yellow colour, and being saturated with nitric acid becomes orange, and causes red precipitates in solutions of nitrate of silver and of mercury, and a yellow one in a solution of acetate of lead.

Gamboge is distinguished by the yellow emulsion which is formed in the water containing the dissolved confectionary of which it forms a part. For the purpose of separating it the confectionary should be treated with rectified alcohol. Water added to the alcoholic solution, causes the precipitation of the resinous part of this gum. The portion held in solution by the water is changed to a red colour by the addition of a few drops of solution of ammonia.

Scheele's green and Schweinfurt green, the former of which is an arsenite of copper, and the latter a compound of an acetate and an arsenite of copper, can be detected by the garlic odour which they exhale when thrown upon hot coals, and by the sublimate of metallic arsenic which is formed when they are mixed with black flux and subjected to heat in a glass tube.

Minium is converted into a brown-coloured powder by the action of nitric acid, and when calcined in contact with carbon, yields a globule of metallic lead. Vermillion is not acted on by nitric acid, but when thrown upon red-hot charcoal burns with a bluish flame, and gives out the odour of sulphur. When calcined in a small tube with iron filings it is reduced to metallic mercury.

Besides these colouring materials, other substances are

mixed with confectionary, which, although not poisonous, are indigestible. Thus sugar plums almost always contain sulphate and carbonate of lime; and pastry cooks often add alum to certain kinds of *bon-bons* to increase the lightness of the paste.

The papers which are used as envelopes of confectionary are also sometimes coloured with the poisonous substances above mentioned. Children often put these papers into their mouths, and accidents have been known to occur in this manner.—(*See Garnier and Harel.*)

CONIUM.

Conii Folia, U. S.—*Hemlock*.

The leaves of the *Conium Maculatum* L., which inhabits various parts of Europe, Asia and America. They are large and tripinnate; leaflets lanceolate, pinnatifid, with acute and often cut segments. In the fresh state they have a glaucous green colour, and have the characteristic odour of the plant. They have a nauseous, bitter taste. By drying they lose much of their odour, and acquire a dull greyish green colour. The active principle of the leaves and fruit is a vegeto-alkali, which has been called *Concine*, or *Conia*. It is a colourless, oily liquid, which has a peculiar penetrating and disagreeable odour, an intensely acrid taste, and is a most active poison.

Other umbelliferous plants, which bear a general resemblance to the conium, are frequently confounded with it, and their leaves are often sold for those of the true plant. The only mode of discrimination is afforded by a close attention to the botanical characters of this species. Chemically all parts of the conium are known by the peculiar odour of concine which is evolved on trituration with caustic potassa.—(*Neligan, Medicines, their Uses, &c.*)

COPAIBA.—*See* BALSAM OF COPAIBA.

COPPER.

Cuprum, U. S.

This well-known metal is distinguished from all others, except titanium, by its red colour. It is malleable and ductile, has a specific gravity of 8.89, is less fusible than silver and more so than gold. The commercial copper is seldom free from iron, which can be detected by dissolving it in muriatic acid and adding to the solution a sufficient quantity of ammonia to dissolve the copper, which will give a deep blue solution, when the iron will be thrown down in the form of brownish red flocks. Perfectly pure copper may be obtained by dissolving the copper of commerce in muriatic acid; the solution is diluted and a plate of iron immersed, upon which the copper is precipitated. After washing it in dilute sulphuric acid to separate a little iron that adheres to it, it may be fused into a button.

Copper almost always contains lead, and it is stated by Dumas that one-thousandth part of this metal affects the tenacity of copper, and renders it unfit for the manufacture of wire. To ascertain its presence dissolve the metal in nitric acid, and add dilute sulphuric acid to the solution. If any lead is present a white precipitate is formed, which is soluble in a solution of potassa, and is instantly blackened by being moistened with the hydrosulphuret of ammonia.—(*Chimie appliquée aux Arts.*)

COPPER, ACETATE OF.

Crystallized Verdigris—Distilled Verdigris.

This salt is prepared by dissolving common verdigris in acetic acid; the solution is put into pans and allowed slowly to crystallize, generally upon twigs or pieces of string sus-

pended in it. It is in the form of oblique rhombic prisms, of a rich bluish green colour, soluble in five parts of water. It is frequently adulterated with sulphate of copper, which can be detected in the manner described under DIACETATE OF COPPER.

COPPER, AMMONIACAL SULPHATE OF.

Cuprum Ammoniatum, U. S.

This is in the form of a deep blue crystalline powder or dark blue crystals. It is soluble in one and a half parts of cold water, and insoluble in alcohol. When exposed for a long time to air it loses ammonia and crumbles down into a green powder, (a mixture of sulphate of ammonia and carbonate of copper.) It is then insoluble in water. If it leaves a brown powder when dissolved in nitric acid, it contains oxide of iron.

COPPER, DIACETATE OR SUBACETATE OF.

Cupri Subacetatis, U. S.—*Common Verdigris*.

This substance is procured by the action of acetic acid, obtained from the refuse of grapes, upon copper. It is usually a mixture of acetate and subacetate of copper in variable proportions, and is often adulterated with foreign bodies, as pieces of copper, grape stalks, &c. The proportion of the latter can be ascertained by dissolving the verdigris in water and filtering the liquid through paper. To the filtered solution add a solution of chloride of barium. If this produces an abundant precipitate, soluble in muriatic acid, the verdigris contains tartrate of copper; if the precipitate is insoluble in this acid, we infer the presence of sulphate of copper. Chalk, which is also used as an adulterant of this substance, is insoluble in water, but dissolves, with effervescence, in dilute muriatic acid; and the solution give a white precipitate with oxalate of ammonia.

COPPER, SULPHATE OF.

Cupri Sulphas, U. S.—Blue Vitriol.

A salt occurring in rhomboidal crystals of a fine blue colour, having a styptic metallic taste and an acid reaction. It effloresces slightly on exposure to the air, and becomes covered with a greenish white powder. It is soluble in about four parts of water at 60° F., and in two parts of boiling water. The solution should remain clear on exposure to the air. If it deposits a precipitate, it may be finely divided copper owing to the mixture of protosulphate of copper, or it may be peroxide of iron, or a basic salt of the peroxide of iron. To determine which, dissolve the precipitate in muriatic acid, and add excess of ammonia. Upon allowing the mixture to remain exposed to the air a blue solution will be produced by oxide of copper, and a brown red precipitate by oxide of iron. If the blue vitriol dissolves without residue it may still contain a salt of iron. Add ammonia to the solution in excess when a beautiful blue transparent solution will be formed. If a reddish brown insoluble precipitate appears, it proves the presence of a considerable proportion of iron. If zinc is suspected to be present, it may be detected by the following process. Acidulate the solution with sulphuric acid, and precipitate the whole of the copper by sulphuretted hydrogen gas; filter the solution from the precipitate; make it boil, and while it is boiling add a solution of carbonate of potassa. If a white precipitate is produced, let it cool, then filter, wash and dry it. If this precipitate becomes yellow when heated and white when cold, the presence of zinc is demonstrated.

CREASOTE.

An oily colourless liquid, with a penetrating, disagreeable odour, similar to that of smoked beef. Its taste is burning and caustic, its specific gravity about 1.037 at 68° F. It

boils at 397° F., and is not congealed at a temperature of 16.6° F.; it burns with a smoky flame; combines with acetic acid, water, alcohol, ether, and with the alkalies; it also coagulates albumen.

Creasote, when pure, is perfectly colourless; but that which is sold in the shops often has a brownish tinge. This may be owing to the presence of oil of tar, capnomor, and other impurities. They may be detected by mixing separate portions of the suspected liquid with acetic acid and solution of caustic potassa. Pure creasote is completely soluble in these liquids, while the adulterated article is not. Fixed oils are also discovered by a stain on paper which is not discharged by heat. If the creasote is very light it may be adulterated with alcohol. This may be separated by careful distillation, the alcohol coming over first and distinguishable by its burning with a clear instead of a smoky flame.

CROCUS.—*See* SAFFRON.

CROTON OIL.

Tiglii Oleum, U. S.

This oil is obtained from the seeds of the *Croton Tiglium* L., a native of the Molucca Islands and of Cochin China. It has a yellowish or brownish colour, a consistence like that of nut oil, a very disagreeable odour, and an extremely acrid taste. It is soluble in sulphuric ether, and partly so in alcohol. As this is a very active medicine, a drop or two producing the most violent purgative effects, adulterations may cause more serious consequences than in less powerful articles. If a sample which has been adulterated with certain fixed oils, of which a dose may be several drops, is followed by a pure oil, the most alarming results may be produced.

The following test of the purity of Croton oil is given by the Edinburgh College. "When agitated with its own vol-

ume of pure alcohol and gently heated, it separates on standing, without having undergone any apparent diminution." But this does not accord with the researches of Dr. Nimmo, who states that croton oil consists of two portions, one acrid and purgative, amounting to forty-five per cent., soluble in cold alcohol, the other a mild oleaginous substance like olive oil, soluble in ether and oil of turpentine, but very slightly soluble in hot alcohol, by which it is deposited when the liquor cools.

CUBEBS.

Cubeba, U. S.

The dried unripe berries of the *Piper Cubeba* L., a native of Java and Prince of Wales' Island. They are about the size of black pepper, wrinkled on the surface, brownish externally, and containing a single loose seed, which is white and oleaginous within. They are furnished with a stalk two or three lines in length; have an agreeable aromatic odour; and a warm, bitterish, camphorous taste. The powder is of a dark colour and of an oily aspect. Besides other ingredients, they contain volatile oils, and a peculiar principle called *Cubebin*, which closely resembles piperin but is said to differ from it in composition.

Cubebs gradually deteriorate by age; and in the state of powder become rapidly weaker, in consequence of the escape of their active volatile ingredient. They should always be kept whole, and pulverized at the time they are prescribed. The powder is said to be sometimes adulterated with that of pimento, and it is also stated that the berries of the *Uvaria ceylanica* L. are sometimes used under the name of cubebs. They are, however, wholly different from the genuine drug, and may be distinguished by their containing four seeds in each berry, while the latter has but one.—(*U. S. Dispensatory.*)

DRAGON'S BLOOD.

This is a resinous substance, which is brought from the East Indies, Africa and South America, as the produce of several trees, viz. : the *Dracæna Draco* L., the *Pterocarpus santalinus* L., *Pterocarpus Draco* L., and the *Calamus Draco* Willd. It occurs in commerce sometimes in small balls of the size of a pigeon's egg, sometimes in rods like the finger, and sometimes in irregular cakes. Its colour, in lump, is dark brown red, in powder, bright red ; it is friable, and has a shining fracture. Specific gravity 1.196. It is insoluble in water, but readily soluble in alcohol, ether and the oils, with the exception of a slight woody residue. When thrown upon burning coals, it disengages an aromatic odour.

False Dragon's Blood consists of different resins coloured with red sandal, colcothar, Armenian bole and pure dragon's blood. It has not the shining red fracture of true dragon's blood ; its powder has a dull colour ; it disengages a disagreeable odour when thrown on burning coals ; it dissolves in alcohol, but leaves a considerable residue.

ERGOT.

Ergota, U. S.—*Spurred Rye*.

This is a fungus, which is sometimes found upon rye, and other grains and grasses. It consists of grains varying from a few lines to an inch or an inch and a half in length, and from half a line to four lines in breadth. It is cylindrical, or obscurely triangular, curved like the spur of a cock, furrowed or striated on two sides. Colour, externally, purplish brown or black ; internally, whitish. It is inodorous, except when in large quantity, and has a mawkish and somewhat acrid taste. It is inflammable, and burns with a clear yellowish white flame.

Ergot, although in most cases poisonous, is sometimes

used for medicinal purposes. It is liable to adulteration and deterioration. Some specimens, procured for analysis by a celebrated chemist, were found to be only plaster of Paris casts, coloured in imitation of the ergot. The active principle of the fungus resides in the outer covering, and if heavy rains fall at the time when this is soft and moist, it will be washed away, and the hardened nucleus will be entirely inert. But if the weather is fine during the maturation of the fungus, the ergot will be in its highest state of activity.—(*Burnett.*) Ergot is also sometimes attacked by a worm, which consumes the interior of the fungus, and impairs its medicinal properties. In a state of powder it is more liable to deteriorate than when kept entire. Pereira thinks ergot ought not to be used that has been kept for more than two years.

The above facts will probably, in a great measure at least, account for the difference of opinion which prevails in regard to the physiological effects of this article. For further particulars on this subject, see "Observations on Ergot, by Professor J. B. Beck."—(*Transactions N. Y. State Medical Society*, 1842.)

ETHER.—See NITROUS ETHER AND SULPHURIC ETHER.

GALL-NUTS.

Gallæ, U. S.

These are excrescences found upon the leaves and leaf-stalks of a small shrubby species of oak, the *Quercus infectoria* Oliv., found in all parts of Asia Minor, especially in the neighborhood of Smyrna and Aleppo. They are the result of the puncture of a small insect called *Diplolepis gallæ tinctoriæ*, made to deposit its eggs; round which the juice of the tree exudes and dries in concentric portions. When the insect gets fully formed, it eats through the nut, and flies off. There are two qualities of Levant galls. The

first are heavy, compact, imperforated, the insect having not been sufficiently advanced to eat its way through the shell. They are prickly on the surface, have a blackish or bluish green hue, and are about the size of a musket ball. These are called *black*, blue or Aleppo galls. The second are light, spongy, pierced with one or more holes, are smooth on the surface, have a greyish or reddish yellow colour, generally larger than the first. They are called *white* galls. Another kind of an inferior quality, which is smaller, irregular in shape, and of a brownish colour, comes from Calabria, Illyria, Dalmatia, &c., being found on the *Quercus Cerris* L.

GAMBOGE.

Gambogia, U. S.

A gum resin obtained from a plant which inhabits Siam, and which is supposed to be a species of *Hebradendron*, and nearly allied to the *H. Gambogiodes* Graham, from which the Ceylon gamboge is procured. The Siam gamboge, which is the commercial article, occurs in hollow or solid cylinders known by the name of *pipe gamboge*, and in irregularly shaped masses, forming the *cake* or *lump gamboge*. The pipe gamboge is of a rich reddish yellow colour, generally greenish and dusty externally; inodorous, tasteless at first, but soon producing a sensation of acidity in the throat. It has a smooth, shining, conchoidal fracture. The lump gamboge has a duller colour than the former variety, and is of inferior purity.

Some parcels of gamboge are said to be adulterated with starch, and to contain lignin. The former may be detected by the greenish colour produced in the cooled decoction on the addition of the tincture of iodine; and the presence of the latter may be known by the fracture not being smooth and conchoidal.—(*Neligan's Medicines, their Uses, &c.*)

Gamboge is sometimes employed to colour confectionary, but this practice is highly reprehensible. (See CONFEC-TIONARY.)

GENTIAN.

Gentiana, U. S.

The root of the *Gentiana lutea* L., a native of the mountains in the middle parts of Europe. It is in cylindrical, rough and twisted pieces, varying in length and breadth, wrinkled annularly and longitudinally. The larger pieces are split lengthwise. The colour of the epidermis is brownish yellow. Internally the root has a bright yellow colour, and a spongy texture. It has a faint aromatic odour, and an intensely bitter taste. Its active properties are due to a crystallizable principle which has been called *Gentianine*.

The roots of the other species of Gentian are often mixed with those of *G. lutea*, an adulteration of little importance, as they possess nearly analogous properties. The untoward symptoms which have sometimes been observed to follow the administration of what was supposed to be true gentian, have been proved to be owing to the *Veratrum album* L., or white hellebore, which grows in the same districts and has some slight resemblance to it, having been collected by mistake.—(*Burnett's Outlines of Botany*.)

The roots of the belladonna and the monkshood are said also to be sometimes mixed with gentian. All these, however, want the intense bitter taste, and the bright yellow colour internally, of the latter root.

GOLD.

One of the best tests of the purity of this metal is its specific gravity, which is from 19.40 to 19.65. It is very soft and flexible when pure, is less fusible than silver, and is soluble in nitromuriatic acid. On adding protosulphate of iron to this solution, the gold is wholly precipitated as a

brown or brownish yellow powder, quite destitute of the metallic lustre, which, however, appears when the powder is rubbed. The presence of copper and silver may be determined by boiling the granulated metal in concentrated sulphuric acid, which dissolves both the silver and the copper, leaving the gold nearly pure, in the form of a black powder. The solution is then placed in a leaden vessel containing metallic copper ; this is gradually dissolved, and the silver is precipitated in a pure metallic state. The presence of copper may be previously determined, if necessary, by the addition of ammonia, with which it forms a blue solution. Or after the precipitation of the silver, the whole sulphate of copper may be obtained by evaporating the solution.

The only common metal with which gold can be contaminated, without reducing the specific gravity, is platinum, but this is not likely to be used in consequence of the change of colour which it produces. Even a twentieth part of platinum greatly deteriorates the colour of gold. An alloy of four of platinum and one of gold, nearly resembles platinum in colour ; the gold colour does not predominate till it forms eight-ninths of the alloy.

A mode of counterfeiting gold coin which has recently been somewhat practiced, is to prepare an alloy of the proper specific gravity by the introduction of a sufficient quantity of platinum, and then to cover the coin with a coating of gold, by the electrotype process. Such a fraud can be detected only by filing through the coating, or by subjecting the coin to heat. The infusibility of the platinum will distinguish from most other metals. To separate it from gold, dissolve the alloy in nitromuriatic acid, the platinum may be thrown down by muriate of ammonia ; afterwards the gold may be precipitated by the protosulphate of iron.

GOLD, CHLORIDE OF.

It occurs in small crystalline needles, of an orange red colour. It has a styptic, disagreeable taste, is soluble in alcohol, ether and water, forming a solution of a beautiful yellow colour. Chloride of silver is insoluble, and will therefore remain unacted on when the chloride of gold is dissolved in water. The real value of a sample may be ascertained by the application of heat, when the chlorine will be driven off, and metallic gold remain in the crucible. The solution of chloride of gold must give a brown precipitate upon the addition of protosulphate of iron, and a purple precipitate with the protochloride of tin.

GOLD, IODIDE OF.

A yellowish brown powder insoluble in cold water, and very sparingly soluble in hot, easily decomposed by heat, and by the liquid alkalies. When heated in a crucible, it evolves iodine vapour, and leaves metallic gold. In this way the purity of this costly substance may be determined.

GOLD AND TIN, OXIDE OF.—*See* PURPLE OF CASSIUS.

GRAPHITE.

Black Lead.—Plumbago.

A mineral of a lead grey colour, a metallic lustre, soft to the touch, and staining the fingers with a lead grey colour. It is employed for counteracting friction between rubbing surfaces of wood or metal, for making crucibles and portable furnaces, and for giving a gloss to the surface of cast iron. The Graphite brought into market from the northern part of New York is largely mixed with magnetic iron ore, which can be proved by passing a magnet through the powder. The magnetic oxide will adhere to the poles of the magnet.

The excuse offered for this adulteration is, that without this addition to the graphite, it cannot be reduced to powder in the mill.

GUAIAIC.

Guaiaci Resina, U. S.

This is the concrete juice of the *Guaiacum officinale* L., a large tree growing in the West Indies, and in the warmer parts of the neighbouring continent. It occurs in pieces of a deep greenish brown or dark olive colour on the external surface, reddish brown internally. It has a feeble but fragrant odour, a taste which at first is scarcely perceptible, but after a short time becomes acrid. It is brittle, and when broken, presents a shining, glassy surface. The powder is at first of a light grey colour, but becomes green on exposure to light. Its specific gravity varies from 1.20 to 1.23. When pure, it is wholly dissolved by alcohol, giving a deep brown tincture which is decomposed by water, and affords blue, green and brown precipitates with the mineral acids.

Guaiac is sometimes adulterated with the resin of the pine, a fraud which may be detected by the terebinatè odour given out when such guaiac is thrown upon burning coals, as well as by its partial solubility in hot oil of turpentine. It is said also to be adulterated with amber. Paper moistened with a tincture of guaiac, if exposed to the fumes of nitric acid, speedily becomes blue, affording an excellent test of this drug.—(*U. S. Dispensatory*.)

The wood of the *Guaiacum* (*Guaiaci Lignum* U. S.) may be detected, according to Schwacke, by pouring a few drops of solution of perchloride of mercury over some shavings of the wood in a test tube, and slightly warming it over a spirit lamp; a bluish green colour is immediately produced with all the genuine samples.—(*The Chemist*, March, 1846.)

GUM ARABIC.

Acacia, U. S.

This substance may be procured from upwards of forty species of *Acacia*, but the gum Arabic of commerce is principally obtained from the *A. Arabica Willd.*, *A. vera Willd.*, *A. gummifera Willd.*, natives of the banks of the Nile, and of Arabia. It occurs in commerce in the form of small pieces, rounded upon one side, and hollow upon the other. It is transparent, without smell, brittle, easy to pulverize, colourless, or with a yellowish or brownish tint. Its specific gravity is 1.355. Gum Senegal, which is the produce of the *Acacia Senegal Willd.*, is usually in larger masses, of a darker colour, and more clammy and tenacious than gum Arabic. Its specific gravity is 1.436. The gum of the cherry and plum tree, which is often mixed with the preceding, is generally in irregular pieces, strongly coloured, and much less brittle than gum Arabic. When put into water, it dissolves but partially, whereas gum Arabic and gum Senegal are completely soluble.

Gum Arabic is often sold in powder, when it is usually adulterated with starch, or wheat flour. Sulphate of lime or gypsum has also been found in large quantity in this powdered gum. Shake a little of the gum with some cold water in a glass tube. The gum dissolves, and the starch, flour and sulphate of lime, if present, fall to the bottom. Boil the gum in water, add a little nitric acid, and when cold, a few drops of a solution of iodide of potassium. The formation of a blue colour indicates the presence of starch or flour. Mix a little of the suspected gum with a few drops of water to a dough, fix this on the end of a platinum wire, and calcine it in the flame of the blow-pipe. If it does not burn quite away, but leaves a substance which shines very brightly

when the blow-pipe flame is directed on it, and which is insoluble in water, the gum probably contains sulphate of lime. At all events, the incombustible substance is not gum.

GUNPOWDER.

The strength and goodness of gunpowder may be judged of in various ways. 1st. By the colour and feel. 2d. By ascertaining whether it is well granulated, or whether the grains have been broken. For this purpose pass the dry hand into a vessel of the gunpowder : if the granulation is perfect the hand will not be blackened. 3d. Fire a small pinch of the gunpowder upon a piece of white paper or card : if good there will be but a slight residue. 4th. But the most certain mode of determining the strength of gunpowder is by measuring the actual projectile force by the *eprovette*, and by the distance to which a given weight of it will project a ball of the same weight under circumstances exactly similar. On this subject see *Ure's Dictionary of Arts, &c.*

HOG'S LARD.

Adeps, U. S.

Lard, when pure, is white, a little granular, of a soft consistence, and almost destitute of taste and odour. It is insoluble in water, partially soluble in alcohol, more so in ether and the volatile oils. It melts at about 85° F. into a clear transparent liquid, but if water is present this liquid is whitish or milky. When melted it readily unites with wax and resins.

It is often adulterated with other fats, which give it a dark colour and a disagreeable odour. By exposure to the air it absorbs oxygen and becomes rancid ; on this account it should be kept in well-closed vessels. In this rancid state, lard reddens litmus, is irritating to the skin, and sometimes acts injuriously on substances mixed with it.

The presence of salt also renders lard unfit for pharmaceutical uses. For its removal it is recommended that the lard be melted with twice its weight of boiling water, the mixture agitated, and the lard again separated when cold.

In consequence of the introduction of lard for burning in lamps its consumption has greatly increased. Rancid lard, if in other respects pure, answers sufficiently well for this purpose. But an article is sometimes offered for sale as burning lard, which is largely mixed with refuse resin, oil, or other fats, or perhaps with the cheaper kinds of flour, and which is totally unfit for use. When burned in an iron spoon it sputters and leaves a large coaly residue; in the lamp a thick black crust is soon formed on the wick, and in an hour or two the flame is extinguished.

HONEY.

Mel, U. S.

This article, when pure and fresh, is fluid, but on being kept it gradually forms a crystalline deposit, and is at length converted into a soft granular mass. Its colour is somewhat variable, being white, yellowish, or with a slight brownish tinge. The odour differs with that of the flowers from which it was collected. It is soluble in cold water.

Honey is sometimes adulterated with sand, potatoe starch, wheat or bean flour, to increase its weight and to give it whiteness. In the former case the solution of the honey in water will detect the fraud. If honey, which is mixed with flour or starch, is exposed to heat, it at first is rendered liquid, but as it cools it solidifies and becomes tenacious. The fraud, however, may be more certainly detected by the tincture of iodine. The following process may be employed :

Dissolve two or three drachms of the suspected honey in about three ounces of boiling water, allow the solution to cool, throw it into a glass, and add two or three drops of the

tincture of iodine. If the honey is pure, the liquid remains very limpid and scarcely changes its colour ; if, on the other hand, it contains flour or starch, it will be instantly troubled, take a deep blue tint, and after a few minutes cause a blue precipitate.

In France, the most common adulterant of honey is said to be starch sugar. For some directions in regard to the detection of this substance the reader is referred to the article SUGAR.

HOPS.

Humulus, U. S.

The dried strobiles of the *Humulus Lupulus L.*, a native of Europe and America, and extensively cultivated in various countries. They occur in the form of thin papery scales, of a greenish yellow colour, sprinkled with a yellow powder which has been called *Lupulin*. They have a strong, and somewhat fragrant odour, and an aromatic, bitter and slightly astringent taste.

Hops are said to be sometimes bleached by exposure to the fumes of burning sulphur. In this case they smell of sulphurous acid and are worthless. The best way to judge of their goodness is to rub them between the hands ; we can then determine whether they have the characteristic odour, and the proper quantity of yellow powder.

HYDRARGYRUM.—See MERCURY.

HYDROCYANIC ACID.

Acidum Hydrocyanicum, U. S.—*Prussic acid*.

Various processes are given for the preparation of this acid in the dilute form in which it is employed for medicinal purposes. It is of great consequence that the strength of the preparation should be uniform, and the rules which are

given for this purpose should be followed with great exactness. It should also be recollected that the acid loses strength by being kept. Fatal accidents have occurred from prescriptions with old acid, found after experience to act favourably, being made up with a fresh stock of acid, even though this was exactly of the standard strength. In this case, as in some others, the danger actually arose from too weak an acid having been at first employed.

Diluted hydrocyanic acid should be perfectly colourless, and entirely vaporizable by heat. It should give no precipitate with sulphuretted hydrogen or it contains some metallic matter. If it strongly reddens litmus it must contain some other acid. The presence of sulphuric acid can be detected by the white precipitate, insoluble in nitric acid, produced by the addition of nitrate of baryta or chloride of barium. Muriatic acid is detected by nitrate of silver, which forms a white precipitate insoluble in boiling nitric acid, while the cyanide of silver is soluble in nitric acid at a boiling heat. The presence of either of these acids is only objectionable on account of the difficulty in determining the strength of the hydrocyanic acid; while on the other hand, it is said to confer the advantage of rendering the hydrocyanic acid much less liable to decomposition.

Medicinal hydrocyanic acid is sometimes replaced by concentrated water of bitter almonds. This adulteration can be detected by placing a little of the suspected acid in a phial and afterwards subjecting it to the heat of a sand bath. Hold a piece of blue litmus paper over the mouth of the phial. In proportion as the acid tested is gently heated, the hydrocyanic acid is disengaged and reddens the test paper. This effect is not produced when the liquid operated on consists only of the water of bitter almonds.—(*The Chemist*, Nov., 1844.) One hundred grains treated with nitrate of silver should precipitate ten grains of cyanide of silver. Nitrate of baryta should cause no precipitate if the acid is pure.

HYOCYAMINE, or HYOCYAMIA.

Hyocamine is the active principle of the *Hyoscyamus niger* L. When pure, it crystallizes in transparent, colourless needles, having a silky lustre. It is inodorous, slightly soluble in water, more so than atropine. Taste bitter and disagreeable, like that of tobacco. It is very poisonous, and the smallest quantity applied to the eye causes a dilatation of the pupil which continues for a very long time. The aqueous solution of hyocamine mixed with the tincture of iodine assumes the colour of kermes. It gives a yellowish white precipitate with chloride of gold, and none with that of platinum. By these reagents it can be distinguished from atropine.

The leaves of the *Hyoscyamus niger*, sometimes employed medicinally, are ovate-oblong, amplexicaul, sinuated, of a greenish yellow colour when dry, and have a fetid, narcotic odour, and a bitter, nauseous taste. They lose much of their activity by keeping, and should therefore be gathered every year. The admixture of other leaves may be readily detected by an attention to the above characters.

INDIA INK.—See LAMPBLACK.

INDIGO.

This highly important colouring material is the produce of various species of *Indigofera*, especially the *I. tinctoria* L., *I. Anil* L., and *I. argentea* L. It is also obtained from the *Nerium tinctorium* Roxb., *Isatis tinctoria* L. and *Polygonum tinctorium* Ait. It generally occurs in commerce in the form of square cakes or cubical masses of a deep blue colour, passing into violet purple. On being rubbed by a smooth hard body it acquires the lustre and hue of copper. It is without odour, but has a somewhat metallic taste.

Its density seems to be influenced by its freedom from foreign impurities, as well as by the peculiar mode of manufacture which has been adopted. It is insoluble in water, in cold alcohol and in ether; it is partially soluble in boiling alcohol and oils, which deposit it again on cooling.

Samples of this drug vary greatly in the proportion of pure indigo which they contain. According to Dr. Ure, the range is from about twenty-eight to seventy-five per cent. Several test processes have been proposed. One of these consists in the use of chlorine water. A known quantity of finely-powdered indigo is to be added little by little to a definite volume of chlorine water, till its colour ceases to be destroyed. A standard of comparison must have been previously fixed by a trial with a sample of indigo of known purity. Another mode suggested by Dr. Ure, as susceptible of great precision, is to convert 10 or 100 grains of indigo finely powdered into its deoxidized state, as in the blue vat, by the proper quantity of slaked lime and solution of green sulphate of iron; then to precipitate the indigo, collect and weigh it. The indigo should be ground upon a muller along with the quick-lime, the levigated mixture should be diluted with water, and added to the solution of the copperas. But this exact analytical process requires much nicety in the operator.—(*Dictionary of Arts, &c.*)

IODINE.

Iodinum, U. S.

A soft and friable solid, of a bluish black colour, and a metallic lustre. It produces a yellow stain upon the skin; evaporates slowly in the air at ordinary temperatures, and rapidly if heat is applied, producing violet vapours. It is very sparingly soluble in water, but readily so in alcohol or ether, and forms a blue compound with starch.

The bottles of iodine usually contain less of that substance

than the quantity marked upon the labels, a fraud which has recently been extensively practiced. The presence of slate, coal or graphite, with which it is sometimes mixed, may be detected by their remaining behind when the iodine is volatilized, and by their insolubility in alcohol. Some specimens of iodine exhibit the appearance of a humid mass instead of dry scales: they have been found to contain 20 or 25 per cent. of water.

In this moist state it is unfit for making pharmaceutic preparations of fixed and uniform strength. The fraud may be detected by compressing the iodine between folds of blotting paper. The Edinburgh College directs that such moist iodine, before being used, should be dried by being placed in a shallow basin of earthenware in a small confined space of air, with ten or twelve times its weight of fresh burnt lime, till it scarcely adheres to the inside of a dry bottle.

IODINE, TINCTURE OF.

Tinctura Iodini, U. S.

This is made by dissolving one ounce of iodine in sixteen ounces of rectified spirit. When kept for any length of time its strength varies, owing to the separation of a portion of the iodine in a crystalline form; it also undergoes change by exposure to the light. The iodine combines with a portion of the hydrogen of the spirit and forms hydriodic acid, which reacting upon the spirit gives rise to a little hydriodic ether. As an internal remedy it is therefore unsafe unless very recently prepared.

IPECACUANHA.

Ipecacuanha, U. S.

The root of the *Cephaelis Ipecacuanha* Rich., an herbaceous plant which is a native of Brazil. It is in pieces of

three or four inches in length, about the thickness of a goose quill, irregularly twisted, and marked with numerous small, but deep, circular rings; internally it exhibits a small white woody fibre, from which the thick greyish brown bark is detached with difficulty. The bark has a brittle and resinous fracture, a faint nauseous odour, and a bitter, somewhat acrid taste. Its active properties reside in a peculiar principle called *Emetine* or *Emetina*, which is very soluble in alcohol, but sparingly so in water.

Ipecacuanha, when in the form of powder, is liable to be mixed with other roots, the presence of which it is not easy to detect. When adulterated with tartar emetic, as is said to be the case with what are called *Ipecacuanha lozenges* and other reputed preparations of this root, and which may produce serious accidents, the fact may be easily ascertained by the following process: Dissolve the suspected preparation in water slightly heated, filter, and treat the clear solution with sulphuretted hydrogen. If any tartar emetic is present an orange red precipitate of sulphuret of antimony will be produced.

IRON.

Ferrum, U. S.

This metal, when in a state of purity, has a bluish white colour, is susceptible of a high polish, is malleable and ductile, and more tenacious than any other. It is attracted by the magnet, but when perfectly pure, does not retain magnetism. Specific gravity 7.78. In the form of filings it is sometimes employed medicinally. They are liable to contain copper, a fact which may be determined by shaking them with solution of ammonia in a small open bottle. If copper is present, a blue colour will after a time be communicated to the ammonia. If mixed with sand the iron filings may be separated by the magnet. They should be kept in a clean, dry, and well-closed bottle.

IRON, BLACK OXIDE OF.

Ferri Oxidum Nigrum, E.—Martial Ethiops.

To obtain this oxide, the scales collected round the anvils of smiths are washed, dried and purified from dross, by the employment of a magnet. These are then reduced to powder, and the finer parts separated by suspension in water. It is easily soluble in muriatic acid, and its recent solution gives green precipitates with the alkalis, which, on exposure to the air, become red. If it becomes blue when mixed with an excess of ammonia, it contains copper; and if its solution in muriatic acid is attended with effervescence, it contains metallic iron.

IRON, CARBONATE OF.

Ferri Subcarbonas, U. S.

This salt is formed by the addition of carbonate of soda to a solution of protosulphate of iron. The greenish white precipitate should be washed, and preserved in a moist state in a close vessel. On being exposed to the air, it evolves carbonic acid, and is converted into the reddish brown hydrated peroxide. This is the common form of most of the samples called carbonate of iron in the shops. The pure carbonate is white or greenish white, and completely tasteless; but it is exceedingly difficult to prevent its decomposition. Its colour and the effervescence caused by acids will be sufficient tests of this substance. After solution, the presence of iron may be exhibited by adding an excess of ammonia, when the characteristic precipitate will be formed.

IRON, FERROCYANIDE OF.—*See* PRUSSIAN BLUE.

IRON, LACTATE OF.

This salt, when pure, occurs in white crystalline plates, which undergo little change upon exposure to the air. It is

soluble in forty parts of boiling water. It has a mild ferruginous taste, and an acid reaction. The aqueous solution becomes yellow by exposure to the air, in consequence of the peroxidation of the iron.

This salt is adulterated by effloresced sulphate of iron, starch and lactine. The first of these substances may be detected by the addition of chloride of barium to the solution of the suspected salt. Lactate of baryta is soluble, but the sulphate of baryta is insoluble. The presence of starch may be detected by the blue colour produced by the tincture of iodine. Lactine is soluble in about six parts of cold water, whereas lactate of iron requires about forty parts of boiling water for its solution.

Lactate of iron should only be purchased when in the form of white crystalline plates. If it occurs as a yellowish or greenish white powder, it is impure.

IRON, PERCHLORIDE OR SESQUICHLORIDE OF.

This is employed in medicine, in the form of a solution in alcohol, under the name of *Tincture of Chloride of Iron*. It has a brownish yellow colour, and a very austere and styptic taste. The solution should be clear, should give a brown red precipitate upon the addition of alkalies, and have a specific gravity of about 0.992. A fluid ounce when decomposed by potassa, should give nearly 30 grains of sesquioxide of iron.

For the purposes of chemical analysis the perchloride of iron must not contain acid in excess: a portion of it must, therefore, when stirred with a small rod dipped in ammonia, yield a precipitate which is not re-dissolved on shaking the vessel. Red ferrieyanide of potassium must not give a blue tinge to its solution.

IRON, PROTIODIDE OF.

Ferri Iodidum, U. S.

This compound is prepared by digesting iodine with water and iron wire, or iron filings, the latter being excess. It may be obtained in a grey crystalline mass by evaporating the solution to dryness out of contact of air. The application of heat is apt to expel the iodine and leave sesquioxide of iron. It is soluble in water and in alcohol. If recently prepared, the solution in water has a pale green colour ; but if it has been prepared for some time, it contains some sesquioxide of iron, and is not entirely soluble. The aqueous solution is liable to spontaneous decomposition, and assumes an orange red colour, free iodine being generated, and sesquioxide of iron deposited. This change may be prevented by adding some sugar to the solution.

IRON, SULPHATE OF.

Ferri Sulphas, U. S.—*Green Vitriol*—*Copperas*.

This salt occurs in the form of oblique rhombic prisms, which are transparent and of a pale green colour. It has a strong, styptic, inky taste, is soluble in one and a half parts of cold, and in one-fourth its weight of boiling, water. On being exposed to moist air, it becomes of a rusty red colour from the absorption of oxygen, whence the French term *couperose*, corrupted into *copperas*, has been applied to it.

When the sulphate of iron has something of an emerald colour, it is impure. The presence of copper or zinc may be accurately determined as follows: Dissolve the salt in water and boil it with a small quantity of nitric acid, until it becomes clear, adding more nitric acid if it becomes necessary. Precipitate the oxide of iron by an excess of ammonia. If much copper is present, the liquid will then be blue.

Neutralize the ammonia by sulphuric acid, and add a solution of the yellow ferrocyanide of potassium. If this produces a red precipitate, it indicates the presence of copper; if it produces a white precipitate, it indicates the presence of zinc.

Some specimens of commercial copperas have recently been found to contain arsenic. The presence of this metal may be detected by dissolving a portion of the salt in water, with the aid of heat, precipitating the oxide of iron by excess of ammonia, filtering the solution, and after adding muriatic acid, so as to be slightly in excess, passing a stream of sulphuretted hydrogen through the solution. If a yellow precipitate is produced, which, upon being mixed with cyanide of potassium and heated in a glass tube, gives a metallic sublimate, the presence of arsenic may be inferred.

Copperas is frequently mixed with sulphate of the sesquioxide. This may be known by the yellowish green colour of the crystals, and by the blue colour produced on the addition of ferrocyanide of potassium.

IRON, RED OXIDE OR SESQUIOXIDE OF.

Ferri Sesquioxidum, L.—*Ferri Subcarbonas*, U. S.—*Crocus Martis*—*Colcothar*.

A reddish brown, tasteless, insoluble powder, obtained by subjecting the sulphate of iron to a very high temperature, and also by decomposing a solution of iron in nitromuriatic acid by an alkali, washing and drying the precipitate.

Sesquioxide of iron is not attracted by the magnet, should not deliquesce on exposure, nor give an acid reaction. It should be entirely soluble in muriatic acid without effervescence, and should give a red brown precipitate with the alkalies. If it contains copper, which is sometimes the case, when it is procured by the decomposition of green vitriol, its muriatic solution will deposit this metal upon a

clean plate of iron. After the sesquioxide has been thrown down from the muriatic solution by ammonia, the supernatant liquor should give no indications of containing any other metal in solution; and chloride of barium ought not to occasion any precipitate. Orfila obtained traces of arsenic in the red oxide of commerce, by boiling this substance for five hours with pure sulphuric acid, and placing the solution in Marsh's apparatus.

The preparation known under the name of the *hydrated peroxide* or *hydrated sesquioxide of iron*, is the red oxide combined with water. The U. S. Pharmacopœia recommends the following mode of preparation, which is here introduced in consequence of its important use as an antidote to the poisonous effects of arsenious acid: "Take of sulphate of iron *four ounces*; Sulphuric acid *three fluid drachms and a half*; Nitric acid *six fluid drachms* or *a sufficient quantity*; Water *two pints*. Dissolve the sulphate of iron in the water, and having added the sulphuric acid, boil the solution; then add the nitric acid in small portions, boiling the liquid for a minute or two after each addition, until the acid ceases to produce a dark colour. Filter the liquid and allow it to cool, and add solution of ammonia in excess, stirring the mixture briskly. Wash the precipitate with water until the washings cease to yield a precipitate with chloride of barium, and keep it in close bottles with water sufficient to cover it." It is of great consequence that this preparation, when it is intended to be used as an antidote for arsenic, should be kept in a moist state. As obtained above it contains a little ammonia, which is thought to assist its antidotal powers. When ignited it becomes anhydrous, and it is then totally inefficient as an antidote. It should, if possible, be recently prepared.

IRON AND POTASSA, TARTRATE OF.

Ferri et Potassæ Tartras, U. S.

An olive brown inodorous powder, with a styptic, inky taste. It is mildly alkaline, slightly deliquescent, dissolves in about four times its weight of water, and slightly in alcohol. Tincture of galls causes a dark coloured precipitate, but ferrocyanide of potassium does not produce a blue colour with it, unless a few drops of acid be added. It is not decomposed by potassa or soda at ordinary temperatures. Tartaric acid causes the formation of crystals of cream of tartar. Heated out of contact of air it yields charcoal, carbonate of potassa and protoxide of iron.

In commerce we frequently meet with an imperfectly prepared compound, in which none or only part of the sesquioxide of iron is in chemical combination with bitartrate of potassa. In this state it is only partially soluble in water, and the solution strikes a blue colour with the ferrocyanide of potassium, and throws down a reddish brown precipitate with solution of potassa.—(*Pereira*). It sometimes also contains metallic iron, the presence of which can be detected by the magnet. Carbonate of potassa has, moreover, been found in many specimens of this salt; they are very deliquescent, and effervesce with dilute acids.

JALAP.

Jalapa, U. S.

The root of the *Ipomæa purga Wenderoth*. (*I. Jalapa Nuttall*), a native of Mexico. It is tuberous, of an oval shape and varying from the size of a nut to that of an orange, generally incised more or less deeply in different directions. The tubers are covered with a thin brown wrinkled cuticle. Internally they are of a yellowish grey colour, marked with deep brown concentric zones. The flat pieces

are merely transverse slices of the entire tubers. The fracture is resinous ; odour faint and disagreeable ; taste nauseous. The active principle, which is a resin, is soluble in alcohol.

Jalap was at one time mixed with slices of Bryony root, but the white coloured intense bitterness of the spurious root rendered the fraud easy of detection. On the Continent many forms of spurious or counterfeit Jalaps are met with, mixed with the true root ; they may, for the most part, be distinguished by being very rugose, of a reddish or rose colour internally, not compact, with a faint odour, and almost insipid.—(*Neligan.*) Jalap is also liable to the attack of insects, and thus becomes what is called *worm-eaten*. But in such cases the starch only is consumed, and there is more resin in proportion to the weight. Worm-eaten jalap, therefore, is well adapted for the preparation of extract.

st *Jalap resin* may be distinguished from scammony resin by its not forming an emulsion when triturated with milk. Its insolubility in oil of turpentine is a means of detecting the intermixture of some other resins.

KINO.

Kino, U. S.

This is the concreted or evaporated juice of the *Pterocarpus erinaceus* Lamarck, a native of Senegal ; and of other undetermined plants. As it usually occurs, it is in the form of small angular fragments, scarcely larger than a pea, opaque, glistening and of a reddish black color. They are brittle, when chewed stick to the teeth, and give the saliva a reddish black colour. They are without odour, have an intensely astringent taste, are partially soluble in water, and more largely so in alcohol.

Kino is often mixed with other astringent substances of

inferior value. These, however, all want the reddish black colour and glistening fracture which are so characteristic of kino.

LAMPBLACK.

This is a form of carbon obtained chiefly by turpentine manufacturers from refuse resin, which is burned in a furnace so constructed that the dense smoke arising from it may pass into chambers hung with sacking, where the soot is deposited, and swept off from time to time and put up in papers for sale. But this article is often quite impure, containing in addition to carbon, some resinous and bituminous matters and several saline substances, together with some ulmine. These impurities may be removed by digestion in alcohol, washing in solution of potassa, then with muriatic acid, and finally with water ; after which it is to be dried.

The lampblack from camphor furnishes the basis of the best India ink, on which account it always has the odour of that substance. Most of the India ink, however, is made from oil-lampblack, occasionally disguised, as to smell, with musk or a little camphor black. The binding substance is gelatine made from parchment or ass' skin. Sometimes common glue is employed, which gives the ink when in use, especially in warm weather, a very offensive odour.

LEAD.

This well-known metal is of a bluish white colour, and has considerable malleability and ductility. Its specific gravity is about 11.40. It melts at 612° F. ; and when exposed to a red heat with free access of air it smokes and sublimes, giving off a grey oxide which collects on surrounding bodies.

The lead of commerce generally contains copper and iron, and sometimes zinc and traces of silver. Dissolve it in nitric acid, dilute the solution and add diluted sulphuric acid.

The lead will thus be thrown down in the form of a sulphate, insoluble in acids. Filter, and add to the clear solution, some solution of ammonia. If a blue colour results, it is owing to the presence of copper. A red brown precipitate indicates iron. To detect silver, if in notable proportion, dilute the nitric solution and then add some muriatic acid. Chlorides of iron, copper and lead are dissolved, (the latter, however, requiring for this purpose a large quantity of water,) while chloride of silver is insoluble in water or dilute acids, but is soluble in ammonia. On exposure to the air its white colour is changed to a violet.

LEAD, ACETATE OF.

Plumbi Acetas, U. S.—*Sugar of Lead*.

This salt, when pure, crystallizes in long six-sided prismatic crystals. It has a taste at first sweet and then astringent; effloresces when exposed to the air, and is partially converted into a carbonate. It should therefore be preserved in well-closed bottles. It is soluble in both water and alcohol. When heated with sulphuric acid, the vapour of acetic acid is disengaged, and when treated with liquid sulphuretted hydrogen the lead is thrown down in the form of a black sulphuret.

Acetate of lead is sometimes adulterated with carbonate of lead, acetate of lime and acetate of iron. The presence of the former may be detected by its want of solubility in water. To determine whether it contains the other acetates throw down the whole of the lead by sulphuretted hydrogen. To the filtered liquor add ammonia. If any iron is present a red brown precipitate will be formed. If the acetate contains lime, oxalate of ammonia will cause a white precipitate in the clear solution.

LEAD, CARBONATE OF.

Plumbi Carbonas, U. S.—*White Lead*—*Cerusse*.

Carbonate of lead, when pure, is usually in the form of a heavy white powder, insoluble in water. Its specific gravity varies from 6.40 to 6.75. It entirely dissolves, with effervescence, in dilute nitric acid. By exposure to heat it becomes yellow, and with charcoal it is reduced to the metallic state. It is immediately discoloured and ultimately blackened by sulphuretted hydrogen, and is one of the most delicate tests for the presence of that gas.

The commercial carbonate of lead is often largely adulterated with chalk, sulphate of lead and sulphate of baryta. It almost always, moreover, contains a portion of oxide of lead. The following processes may be employed for ascertaining the presence and proportions of these adulterants.

Detection of Sulphates.—Mix a weighed portion of the suspected white lead in a Florence flask with dilute nitric acid, adding the white lead or the acid gradually, to render the effervescence moderate. Boil the mixture over a lamp for a few minutes. If the white lead dissolves entirely, it is free from sulphates. If it leaves a precipitate, let the solution settle, filter it, and wash the precipitate on the filter till the liquor which runs through it gives no precipitate with sulphate of soda. Weigh the precipitate after it has been dried, and boil it in a glass flask with a solution of caustic potassa. If it dissolves entirely it is sulphate of lead. If it leaves a residue, this will be sulphate of baryta. Filter the solution and add a little sulphuretted hydrogen. If it contains lead a black precipitate will be produced. When sulphate of baryta alone is present, the solution of potassa leaves a residue, and the filtered liquor affords no black precipitate when treated with sulphuretted hydrogen. Sulphate

of lead is said also to be soluble in oxalate of ammonia.

Sulphate of lime may be detected in white lead by boiling a portion of the suspected powder in a large quantity of distilled water. If sulphate of lime is present the filtered solution will give a white precipitate upon the addition of oxalate of ammonia, as the sulphate is sparingly soluble in water.

Detection of Chalk.—To detect the presence of this substance dissolve a little of the suspected white lead in dilute nitric acid. After filtration to separate the insoluble sulphates, dilute the clear solution with water and subject it to the action of a stream of sulphuretted hydrogen, which must be continued as long as any black precipitate is produced. Throw this upon a filter, neutralize the clear solution with ammonia, and add oxalate of ammonia. If any chalk was mixed with the white lead it will be thrown down as a white precipitate of oxalate of lime. The proportion may be determined by calcining this precipitate and weighing it. On the other hand, the proportion of lead may be deduced by converting the sulphuret of lead into sulphate of lead, by treating it with strong nitric acid carefully added, and subsequent ignition and weighing.

Common white lead is also usually mixed with a very minute quantity of lampblack or indigo, the object of which is to give it a bluish tint more agreeable to the eye than the yellowish colour which it naturally possesses. The white lead of Holland is said to be coloured by galena.

LEAD, CHROMATE OF.

Chrome Yellow.

A fine yellow powder, insoluble in water, but soluble in nitric acid and in solution of potassa. Upon being heated its colour is deepened, and it fuses at a red heat. If the

heat be continued, it is converted into oxide of lead and oxide of chromium.

In consequence of the beautiful yellow colour of this compound, its adulteration is very easily accomplished. The substances most commonly found in it are, carbonate of lime, carbonate of lead, sulphate of lime, sulphate of lead, and starch. If carbonates are present a few drops of nitric acid will cause an effervescence. Calcine some of the suspected powder with a quarter of its weight of charcoal in a crucible for an hour. Pound the calcined mixture, and boil it in a flask in a mixture of water and muriatic acid. If it gives out the odour of sulphuretted hydrogen it indicates the presence of a sulphate. Filter the liquor and throw down the oxide of chromium by ammonia. Again filter and add to the clear liquor oxalate of ammonia, which if lime is present will give a white precipitate. If it produces a smoke and gives out the odour of burning vegetable matter, it denotes the presence of starch; or boil a portion of the chromate in water and test the liquor for starch by tincture of iodine.

A more accurate method of analysis, however, is the following: Boil a weighed portion of the chrome yellow with a mixture of muriatic acid and alcohol. The chloride of chromium thus formed dissolves in the muriatic acid, while the chloride of lead is precipitated. The solution is then filtered and the precipitate washed with spirit of wine, and afterwards dried and weighed. 100 grains of pure chromate of lead should yield about 85 of chloride of lead.

According to Dumas a small quantity of sulphate of lime increases the brilliancy of the chromate of lead.

LEAD, IODIDE OF.

Plumbi Iodidum, L.

A beautiful yellow powder, very sparingly soluble in cold water, but readily soluble in boiling water, from which it

usually separates, as the solution cools, in the form of golden yellow brilliant small scales. It is soluble in acetic acid and alcohol. When subjected to heat it first forms a yellow vapour, and afterwards a violet vapour, owing to the decomposition of the iodide. The remaining lead may be dissolved in nitric acid and tested in the usual way.

Iodide of lead may be distinguished from the chromate, by the complete solubility of the former in boiling water, and by the different effect of heat. The Edinburgh College gives the following tests of its purity: "Bright yellow; five grains are entirely soluble with the aid of ebullition in a fluid ounce of pyroligneous acid diluted with one and a half ounces of water; and golden crystals are abundantly deposited on cooling."

LEAD, PROTOXIDE OF.

Plumbi Oxidum Semivitreum, U. S.—*Litharge*.

This is found in commerce in the form of small, thin, transparent scales, which are commonly produced by the artificial oxidation of lead in the treatment of argentiferous lead ores. It generally contains more or less red lead, and hence its variations in colour; and also carbonic acid, especially when it has been exposed to the air. It moreover sometimes contains the oxides of iron and copper.

The best solvents for litharge are the nitric and acetic acids. When it does not entirely dissolve in these reagents it is impure. The mixture of sand or brick dust may thus be easily detected by their want of solubility. To determine the presence of copper and iron proceed as follows: Dissolve the litharge in pure nitric acid, filter the solution from the insoluble matter, if any, and precipitate the lead by adding sulphuric acid. Separate the precipitate by filtration, wash, and mix the solution with solution of ammonia. If the litharge contains copper, the ammoniacal solu-

tion will assume a blue colour. If it contains iron a brown red precipitate will be produced. The proportion of oxide of lead in a given quantity of litharge may be ascertained by subjecting to heat the precipitate obtained by the addition of sulphuric acid to the nitric solution, in order to expel the excess of sulphuric acid. The sulphate is then to be weighed. 100 parts of pure litharge should give about 136 parts of sulphate of lead.

LEAD, RED OXIDE OF.

Plumbi Oxidum Rubrum, U. S.—*Minium or Red Lead*.

This is a powder of a brick red colour. When gently heated it turns black, but again becomes red on cooling. By a strong heat it is converted into protoxide of lead, with the disengagement of oxygen gas. When put into nitric or acetic acid it is partly converted into protoxide which dissolves in the acid, and partly into brown oxide which remains undissolved. If red lead is adulterated, as is often the case, with brick dust, the latter is best detected by treating the ignited oxide with diluted nitric acid; the brick dust then remains undissolved. To detect oxides of iron and copper, which are sometimes mixed with minium, add sulphuric acid to the nitric solution; sulphate of lead will be thrown down. Filter, and add ammonia: a blue solution proves the presence of copper; a brown red precipitate, of iron. The minium obtained from lead which contains either copper or iron cannot with advantage be employed in the manufacture of flint glass, for pottery glazes or for house painting.

LEMON JUICE.—*See* CITRIC ACID.

LIME.

Calx, U. S.

When pure, this is a white or light grey brittle solid, having an acid and caustic taste: it changes vegetable blues to

green. Its specific gravity is 2.30. It is very difficult of fusion, but remarkably promotes the fusion of other bodies, and hence is a cheap and powerful flux. When moistened with water it becomes hot, smokes strongly, and falls to a fine powder, the bulk of which is much greater than that of the lime employed.

Pure lime is obtained by exposing Iceland spar and some other kinds of pure carbonate of lime to a red heat. When common limestone is employed for this purpose, it often contains silica, alumina, and oxide of iron. Dissolve the sample in dilute muriatic acid : if the filtered solution gives a precipitate with potassa it contains alumina, or oxide of iron, or both. Excess of the alkali dissolves the alumina and leaves the oxide of iron. The silica will remain undissolved, and may be separated by filtration. If the calcination has not been properly conducted, the lime will effervesce when treated with a dilute acid ; and in this case also, the specimen does not slake upon the addition of water.

Lime being largely employed as a manure and for the manufacture of mortar, it often becomes important to determine the relative value of various samples. In such investigations the points to be particularly attended to are, as above indicated, the proportion of carbonic acid, which is sometimes considerable through carelessness in the calcination or in the keeping of the lime, and the proportions of silica, alumina and oxide of iron, which it may contain. After having ascertained the presence of carbonic acid by the action of dilute muriatic acid, subject a weighed portion, say 100 grains, to a white heat in a porcelain or platinum crucible, for half an hour. The loss of weight will indicate the amount of water and carbonic acid. Treat the residue with dilute muriatic acid, the whole being introduced into a glass flask, which is to be gently heated in a sand-bath. Filter the solution and carefully wash the precipitate, dry, heat to redness and weigh. To the filtered solution add ammonia

until the acid is completely saturated, then quickly filter, wash, dry, heat and weigh the precipitate. This will be either alumina, oxide of iron, or a mixture of both, and when its weight is added to that of the portion undissolved by muriatic acid, the total amount of earthy matters and of oxide of iron will be determined.

Lime water, which is prepared by mixing hydrate of lime with water and agitating the mixture, has a harsh, acrid taste, and changes vegetable blues to green. It has a strong attraction for carbonic acid, and forms with it an insoluble carbonate; hence lime water should be kept in well-stopped bottles which should be full, or in bottles containing an excess of lime.

LIME, CARBONATE OF.

Creta, L.—*Marmor*, U. S.

This is an abundant native product, and occurs in the form of marble, chalk, &c. The *Creta Preparata* of the Pharmacopœias is obtained by rubbing chalk in a sufficient quantity of water until it is reduced to a very fine powder, and then after a short interval pouring off the supernatant liquid into another vessel that the powder may subside. The water is then drawn off by a syphon and the powder dried and kept for use. This preparation is white, tasteless, almost insoluble in water, and when heated to redness in a current of air, loses its carbonic acid and leaves quicklime.

It should be perfectly soluble with effervescence in dilute muriatic acid. In this solution ammonia should produce no precipitate, otherwise it contains alumina or oxide of iron; nor should sulphate of lime throw down anything, by which the absence of baryta and strontia is proved.

LIME, HYPOCHLORITE OF.—See BLEACHING POWDER.

LIQUORICE.

Glycyrrhiza, U. S.

The article called *Liquorice* is obtained by evaporating to dryness a decoction of the root of various species of *Glycyrrhiza*, as *G. echinata* L., *G. lepidota* Nutt., and *G. glabra* L. It is imported from Spain and Sicily in round sticks of five or six inches in length and about an inch in thickness. Its fracture is smooth and brilliant, its internal colour deep black, and its taste sweet and agreeable. When the sticks are packed up in boxes, previous to exportation, they are stratified with dry bay leaves, to hinder their adhesion to each other. But notwithstanding this precaution, they generally lose their cylindrical form and conglomerate into masses.

An inferior kind of liquorice is found in market, made by mixing a solution of the genuine liquorice with some cheap kind of gum and adding lampblack or other black colouring matter and evaporating the solution until it acquires the proper consistence to be rolled into cylinders. These sticks are packed up in boxes with strata of bay leaves like the genuine liquorice imported from Spain. The real liquorice should dissolve in water without leaving any residue, and by this character, some of the impurities contained in the adulterated article may be detected. Its chief consumption is by the brewers. It has been ascertained that its sweetness depends upon a peculiar form of sugar which has been called *Glycyrrhizin*.

The *Refined Liquorice* is prepared as follows. Take one pound of Spanish liquorice, half a pound of gum Arabic, and enough water to dissolve the mixture; strain the solution through muslin; evaporate it gently till it forms a soft ex-

tract; roll it into cylinders of the size of a quill; cut these into lengths and polish by rubbing them together in a box. An inferior kind is prepared by dissolving Spanish liquorice with an equal weight of carpenter's glue. If this kind is heated in a glass tube or before the blow-pipe, it gives out the odour of ammonia. Another variety of refined liquorice is made by mixing a solution of Spanish liquorice with starch. It is found in commerce in little sticks, which are perfectly cylindrical, and very flexible; its fracture is dull and granular, and sometimes exhibits minute white points, which no doubt result from an imperfect mixture of the component parts of the compound. It divides between the teeth into small lumps, and does not possess the tenacity of the pure liquorice. Treated with cold water, it dissolves but partially, and immediately deposits a dirty white powder, possessing the well-known properties of starch.—(*Domestic Chemist.*) 2

LOGWOOD.

Hæmatoxylon, U. S.

The wood of the *Hæmatoxylon Campechianum* L., a native of Campeachy in Central America, and now naturalized in Jamaica. It is imported in billets about three feet long, the bark and alburnum of which are chipped off. It is hard, compact, heavy, of a deep red colour, a weak, agreeable odour, and an astringent taste. It yields its active principles both to water and alcohol; the solutions are of a fine purple colour, which is changed to violet by the alkalies.

Various red coloured woods are substituted for logwood, from which they may be readily distinguished by not possessing the same agreeable odour.—(*Neligan.*)

LYCOPodium.

This is the pollen or seed of the *Lycopodium Clavatum* L., which is collected in large quantities, and is sometimes

known by the name of *Vegetable Sulphur*. On account of the utter impalpability of the powder, when set fire to, it is at once consumed, and it is hence employed in theatres to imitate a sudden flash of lightning. It is sometimes mixed with talc or with starch. To detect these substances make a paste of the lycopodium with water, and then mix it with a large quantity of water: the lycopodium will swim and the talc sink. Boil the lycopodium in water, and test the liquor by tincture of iodine. If a blue colour is produced, it indicates the presence of starch.

MACE.—*See* NUTMEG.

MADDER.

Rubia, U. S.

The roots of the *Rubia tinctorum* L., and *R. peregrina* L., natives of the Levant and South of Europe; and extensively cultivated in various countries. They are imported whole or in the form of powder. In the former case they are long, cylindrical fibres, from the size of a writing quill to that of the little finger, branched, and externally of a deep reddish brown colour. They have a feeble odour, and a bitterish astringent taste. According to Runge, madder contains five distinct colouring principles; madder red, madder purple, madder orange, madder yellow and madder brown.

A form of madder containing more colouring matter than the natural root is now met with in commerce, under the name of *Garancine*. This article is said to be prepared by digesting powdered madder in cold oil of vitriol, which destroys most of the constituents of the root, but leaves the red colouring matter unaltered.—(*Parnell's Applied Chemistry*.)

It appears that madder differs in the presence or absence of carbonate of lime, depending upon the difference in the soil upon which the plant is reared. Avignon madder indi-

cates the presence of carbonate of lime in it, by effervescing with dilute acids, while Alsace madder does not. A knowledge of this difference is said to be of great importance in the employment of this article as a dye.—(See *Ure's Dict. of Arts, &c.*)

MAGNESIA, CALCINED.

Magnesia, U. S.

A white, insipid, friable powder, of an earthy appearance, which slightly greens the blue of violets and reddens turmeric. Specific gravity 2.30. It is almost infusible and very sparingly soluble in water. It often contains carbonate of magnesia, owing to the imperfect manner in which the calcination has been conducted. To ascertain this fact throw a small quantity of the magnesia into a glass, and cover it with pure water. Then add a small quantity of very dilute muriatic or sulphuric acid. If effervescence is occasioned by the addition of the acid, carbonate of magnesia or of lime is present. The addition of some water previous to that of the acid should not be omitted, as the extrication of air involved between the particles gives the appearance of effervescence which may be mistaken for that arising from carbonic acid. Strong acid, also, when added to magnesia causes such an elevation of temperature as to produce a kind of effervescence. To determine whether the effervescence upon the addition of dilute acid, with the precautions above mentioned, is due to carbonate of lime or carbonate of magnesia, proceed as follows: Dissolve a portion of the powder in muriatic acid, with the aid of gentle heat. Filter the solution and then neutralize it with ammonia, and if the quantity of acid is not considerable, add some solution of muriate of ammonia. Then add solution of oxalate of ammonia, which if lime is present will cause a white precipitate, while the magnesia is held in solution by the muriate of ammonia, an excess of which must be ensured as above directed. Ano-

ther mode of determining the presence of lime when mixed with magnesia is to supersaturate the muriatic solution with ammonia, and then to add a sufficient quantity of muriate of ammonia. The addition of carbonate of ammonia to this solution causes the precipitate of the lime, while the magnesia remains in the filtered liquor and may afterwards be thrown down by phosphate of soda. The presence of a sulphate, a soluble carbonate, silica and alumina, may be determined by the processes indicated in the next article.

The *Heavy Calcined Magnesia* is preferred for medical purposes. It is made by calcining the carbonate of magnesia, previously made into a firm paste with water, dried in an oven and pressed down in the crucible. This kind is less soluble in acid, less liable to condense carbonic acid, and is said to be identical with *Henry's Calcined Magnesia*.

MAGNESIA, CARBONATE OF.

Magnesiae Carbonas, U. S.

Two kinds of carbonate of magnesia are kept in the shops, the *light* and the *heavy*; the difference depending upon the process employed in their manufacture. Both varieties are nearly tasteless, have a feeble alkaline reaction on test paper, and are nearly insoluble in water, but readily dissolve in carbonic acid water. They effervesce on being treated with dilute mineral acids, and are thus distinguished from calcined magnesia.

Carbonate of magnesia may contain carbonate of lime, either fraudulently added, or from a want of care in the preparation of the magnesian compounds. The presence of this substance may be determined by the process described under the preceding article. It also sometimes contains soluble alkaline salts. Boil a portion of the suspected substance for a quarter of an hour in ten parts of water and filter the solution. The clear liquor should have no taste, be without

action on turmeric paper, otherwise it contains alkali; and should give no precipitate with a solution of nitrate of silver, otherwise it contains muriatic acid; or of chloride of barium, otherwise it contains sulphuric acid. The minute quantity of carbonate of magnesia dissolved by the water will scarcely affect the two latter tests.

Detection of Alumina.—Magnesia sometimes contains alumina, the presence of which may be detected as follows: Saturate a small quantity of diluted sulphuric acid with the suspected magnesia, filter the solution, condense to a small bulk by evaporation, and add a solution of potassa, either caustic or carbonated, taking care that the acid is in slight excess. If alumina is present, a crystalline precipitate of alum will, at the end of an hour, be produced. Or dissolve the magnesia in muriatic acid, filter the solution, and supersaturate it with ammonia. If alumina is present a white voluminous precipitate will be formed, the separation of which, from magnesia, may be ensured by the addition of a quantity of muriate of ammonia. Magnesia is almost entirely soluble in muriate of ammonia, but alumina is insoluble in it.

Detection of Silica.—If silica is contained in either the calcined or carbonated magnesia, its presence can be detected as follows: Dissolve a quantity of the suspected magnesia in diluted muriatic acid, and evaporate the mixture without previous filtration to perfect dryness, in a wedge-wood ware basin, applying the heat of a lamp or of a charcoal fire, and stirring the mixture with a glass rod when it gets thick. After it has cooled thoroughly moisten it with strong muriatic acid, allow it to repose for half an hour, and then dilute it with water and filter it. The insoluble powder, if any, is silica.

MAGNESIA, SULPHATE OF.

Magnesiae Sulphas, U. S.—*Epsom Salt*.

This salt crystallizes in small quadrangular prisms, which effloresce slightly in dry air, and also in larger crystals which are six-sided prisms terminated by six-sided summits. The crystals are soluble in an equal weight of water at 60° , and in three-fourths of their weight of boiling water. They have a bitter and disagreeable taste.

This salt sometimes contains chloride of magnesium, when it becomes moist on exposure to the air. It is also frequently contaminated with lime on account of the mode employed in its manufacture. Sulphate of soda, moreover, has been substituted for sulphate of magnesia; and, through carelessness, oxalic acid has been repeatedly mistaken for it, and fatal accidents have thus occurred.

Detection of Chlorides.—The presence of a chloride in sulphate of magnesia may be detected by dissolving a portion of the suspected salt in water, and then adding to the clear solution a solution of sulphate of silver. If a white curdy precipitate is formed, which is insoluble in nitric acid, it indicates the presence of muriatic acid, its chlorine combining with the silver, forming a chloride of silver. The proportion of this adulterant may be determined by filtering the solution, washing, drying and weighing the precipitate.

Detection of Lime.—To detect lime, dissolve the salt in water as before, add muriate of ammonia in sufficient quantity to hold the magnesia in solution, and then render it alkaline, by adding ammonia. If this causes a precipitate, add muriatic acid to re-dissolve it, and again make the solution alkaline by ammonia. When the solution is alkaline and clear, test it with oxalic acid or oxalate of ammonia. If lime is present, a white precipitate of oxalate of lime is produced.

Detection of Sulphate of Soda.—To distinguish between sulphate of soda and sulphate of magnesia, dissolve the salt in water, and add to the solution a small portion of a solution of carbonate of potassa. If the salt contains soda, the solution remains clear; if it contains magnesia, an abundant white precipitate is produced.

If sulphate of soda and sulphate of magnesia are mixed, they may be separated, and the proportion of each determined, although not with absolute accuracy, by the following process: Dissolve the mixed sulphates in water, and add so much acetate of baryta, that all the sulphuric acid is precipitated as sulphate of baryta. The mixture is warmed; the solution of sulphate of baryta separated by filtration; the filtered solution evaporated to dryness; the dry mass ignited in a platinum capsule. By this means the acetates are converted into carbonates. Hot water is poured over the mass after ignition, the carbonate of soda dissolves, while the carbonates of baryta and magnesia remain undissolved. The solution is filtered and the insoluble matteredulcorated with hot water, but the washing must not be long continued. The alkaline solution is evaporated to dryness, and the dry mass is ignited, converted into a sulphate by the addition of sulphuric acid, ignited and weighed. The carbonates of baryta and magnesia, which remained undissolved in water, are dissolved in muriatic acid; the baryta precipitated by sulphuric acid; the solution is filtered from the sulphate of baryta and evaporated to dryness; the dry mass so obtained, which consists entirely of sulphate of magnesia, is ignited and weighed. If only sulphate of soda and sulphate of magnesia are contained in the salt under examination, the weight of the two must agree with that of the mixed sulphates before the separation. This is a tedious and difficult process; but it is the one which is least liable to objection; even this, as before remarked, unless great care is observed, does not afford very accurate results.

Oxalic acid may be distinguished from sulphate of magnesia by the following tests :

| <i>Tests.</i> | <i>Oxalic Acid.</i> | <i>Sulphate of Magnesia.</i> |
|----------------------|---------------------|------------------------------|
| Taste, | Acid, | Bitter. |
| On hot cinders, | Dissipated, | White mass left. |
| Vegetable blues, | Reddened, | No effect. |
| Alkaline Carbonates, | Effervescence, | White precipitate. |

MANGANESE, PEROXIDE OF.

Manganesii Binoxidum, L.

This usually occurs massive, mixed with various other substances, or in the form of minute prisms, and known in mineralogy by the name of *Pyrolusite*. Its specific gravity is from 4.81 to 4.95. In commerce it is generally in the form of a powder, obtained from the earthy hydrated peroxide known by the name of *Wad*. When subjected to a red heat it evolves oxygen gas, and when heated with muriatic acid, it gives out chlorine.

Peroxide of manganese is often very much adulterated, being mixed with charcoal, carbonate of lime, oxide of iron, brick dust, and with peroxide of manganese which has already been made use of in the arts, and of course is worthless. When it is possible, it should always be purchased in lumps. The presence of carbonate of lime may be ascertained by the effervescence of the sample when treated with diluted muriatic acid. If it divides into two portions when merely shaken up with water, the one portion sinking below the liquid and the other rising to its surface, it contains charcoal. In this case the substance which floats on the water must burn away before the blow-pipe, and exhibit the other properties of charcoal. If oxide of iron is present, a red brown precipitate will be produced on the addition of ammonia to the clear muriatic solution of the suspected manganese. Brick dust will remain undissolved by muriatic acid. The following process detects the presence of such manganese as may have been already employed in the pre-

paration of chlorine. Boil the manganese in water, filter the solution, and test it with solutions of chloride of barium and nitrate of silver. If these reagents produce white precipitates, it shows that the manganese is mixed with sulphates and chlorides, and that it has been previously employed in the preparation of chlorine, and afterwards been washed and again delivered to commerce.

Peroxide of manganese is sometimes largely adulterated with peat, and indeed in some cases, perhaps ignorantly, peat has been entirely substituted and sold for it. In the samples purchased for laboratory use, I have several times met with such mixtures. And as peat affords, on being heated, a portion of carburetted hydrogen, when manganese is used for procuring oxygen, the gas should always be tested carefully before it is collected. A tremendous explosion once happened in my laboratory by the introduction of an ignited coil of iron wire into a large vessel of gas, which on examination proved to be a mixture of oxygen gas and of carburetted hydrogen, obtained from a sample of manganese thus adulterated. The first portions of gas obtained from this mixture seemed to have been sufficiently pure oxygen gas, for I had, as I am always in the habit of doing, tested it by the introduction of a taper. This is a precaution which, in the employment of manganese, is absolutely necessary, in consequence of the constant presence of carbonate of lime, and the evolution of carbonic acid, which the first application of a red heat occasions. The same gas is also given out when manganese, adulterated with charcoal, is subjected to heat.

As the higher oxides of manganese are largely employed in the arts, it is important to have an easy and expeditious mode of testing the various samples that are brought to market. The value of these oxides is exactly proportional to the quantity of chlorine which they produce, when dissolved in muriatic acid, and the chlorine can be estimated by the

quantity of protosulphate of iron which it peroxidizes. It has been ascertained by experiment that 50 grains of pure peroxide of manganese yield chlorine sufficient to peroxidize 317 (more exactly 316.5) grains of protosulphate of iron. The process which answers very well for carrying out this test is thus described by Graham :

Fifty grains of the powdered oxide of manganese to be examined are weighed out, and also any known quantity, not less than 317 grains, of the protosulphate of iron (copperas) employed in chlorimetry. The oxide of manganese is thrown into a flask containing an ounce and a half of strong muriatic acid, diluted with half an ounce of water, and a gentle heat applied. The sulphate of iron is gradually added in small quantities to the acid, so as to absorb the chlorine as it is evolved; and the addition of that salt continued till the liquid, after being heated, gives a blue precipitate with the red ferricyanide of potassium, and has no smell of chlorine, which are indications that the protosulphate of iron is present in excess. By weighing what remains of the sulphate of iron, the quantity is ascertained; say m grains. If the whole manganese were peroxide, it would require 317 grains of sulphate of iron, and that quantity would, therefore, indicate 100 per cent. of peroxide in the specimen; but if a portion of the manganese only is peroxide, it will consume a proportionally smaller quantity of the sulphate, which quantity will give the proportion of the peroxides by the proportion: as 317 : 100 :: m : per centage required. The per centage of peroxide of manganese is thus obtained by multiplying the number of grains of sulphate of iron peroxidized by 0.317.—(*Elements of Chemistry.*)

MANNA.

Manna, U. S.

A peculiar saccharine substance which is the dried juice exuding from incisions made into the stem of the *Frax-*

inus Ornus L., (*Ornus Europæa Pers.*,) a native of the South of Europe ; and probably also of other species of this genus.

Two kinds of manna are commonly met with in the shops, viz.: 1. *Flake manna*, called also *Manna cannulata*. It occurs in stalactiform pieces, from one to six inches in length, rough, porous, brittle, of a whitish or yellowish white colour, concave, and often soiled by impurities on the surface by which they were attached to the trunk. The odour is like that of honey ; the taste sweet, but afterwards rather acrid. 2. *Fatty manna*, called also *Manna pinguis*. It consists of small, soft, viscid fragments, of a dirty yellowish brown colour, much soiled and mixed with impurities. Its odour is very nauseous, and its taste disagreeable.

When pure, manna is soluble in three parts of water at 60° F., and in eight parts of rectified spirit. Its active principle, *Mannite*, may be obtained in crystals by boiling manna in alcohol, and pouring off the spirit and allowing it to cool.

Attempts have been made to counterfeit this article, but without much success. A composition of sugar and honey, mixed with a small portion of scammony, has sometimes been substituted for it. The solution in boiling alcohol will readily detect this fraud. Common manna is also purified so as to resemble flake manna. When subjected to the process prescribed for this purpose it contains less mannite than flake manna, and less of the nauseous principle ; but it is said not to operate less effectively as a laxative.—(*U. S. Dispensatory.*)

MERCURY.

Hydrargyrum, U. S.—*Quicksilver*

This metal has a silver white colour, and is distinguished from all other metals by being liquid at ordinary temperatures. When pure, if thrown upon a table it divides into a

multitude of little round drops, but when it is mixed with other metals these drops are elongated. It is often adulterated with lead, tin and bismuth, a fraud which can be detected by its want of fluidity, and by its not being perfectly volatile when boiled in an iron spoon. If the residue is yellowish, dissolves in nitric acid, and if the solution when thrown into distilled water causes a copious white precipitate, it contains bismuth; if no such precipitate is produced, but a white precipitate be thrown down by sulphuric acid, it contains lead. If the residue from the distillation is insoluble in nitric acid, but soluble in muriatic acid, and gives with the latter a solution which affords a yellow precipitate when tested with hydrosulphuret of ammonia, the adulterant is tin. The most efficacious mode of purifying mercury is by subjecting it to the process of distillation in an iron retort.

MERCURY, BICYANIDE OF.

Hydrargyri Cyanuretum, U. S.—*Cyanuret of Mercury*.

This substance occurs in anhydrous prismatic crystals, the primary form of which is a square prism. The crystals are white, colourless, transparent or opaque, inodorous, have a strong metallic taste, and are highly poisonous. Soluble in eight parts of water at 60°, but in less boiling water; very sparingly soluble in alcohol. When perfectly dry, if subjected to heat, it yields cyanogen gas and metallic mercury. Heated with muriatic it evolves hydrocyanic acid.

This compound, when prepared from Prussian blue, has usually a yellowish colour, owing to the presence of oxide of iron.

MERCURY, BLACK SULPHURET OF.

Hydrargyri Sulphuretum Nigrum, U. S.—*Ethiops Mineral*.

This is a black, heavy, insoluble, tasteless powder. When digested in nitric acid it is converted into a sulphate

of mercury ; heated to redness, metallic mercury escapes, and red sulphuret sublimes.

This substance is said to be adulterated with ivory black, which may be detected by exposing the mixture to heat in a glass tube, when a white powder (phosphate of lime) will remain behind. It sometimes contains sulphuret of antimony, which may be detected by boiling a little of the suspected powder in strong muriatic acid, and pouring the clear solution into water ; if antimony is present, a white precipitate will be produced.

Free mercury may be detected in this compound by its communicating a white stain to gold.

MERCURY, PERCHLORIDE OF.

Hydrargyri Chloridum Corrosivum, U. S.—*Corrosive Sublimate*.

It occurs in the form of a white, semi-transparent mass, sometimes perfectly crystallized. It has an acrid and burning taste, leaves a metallic flavour on the tongue, and in solution reddens litmus. Specific gravity 5.20. It is soluble in about sixteen parts of cold, and in three of boiling, water. If it leaves a residue it is probably calomel. Corrosive sublimate must also dissolve in alcohol and sulphuric ether, and volatilize without residue when subjected to heat. When its solution is treated with solution of potassa, a brick red peroxide is precipitated, which becomes yellow ; if the precipitate is blackish it is due to the admixture of calomel.

MERCURY, PERIODIDE OF.

Hydrargyri Iodidum Rubrum, U. S.

A powder of a bright scarlet colour, whose specific gravity is 6.32. It is insoluble in water, but soluble in alcohol, some acids, alkalies and solutions of iodide of potassium

and chloride of sodium. When heated it fuses, forming a ruby-red liquid, sublimes in crystals, which are at first yellow but afterwards become red, and furnish a scarlet red powder.

This substance may be mixed with bisulphuret of mercury, an adulteration which may be recognized by fusing the suspected iodide with caustic potassa in a glass tube, by which a mixture of sulphuret and iodide of potassium is obtained : the iodide of potassium may be removed by solution in water, and the presence of sulphur in the residue may be proved by the evolution of sulphuretted hydrogen upon the addition of muriatic acid. The Edinburgh College prescribes the following tests of its purity : " Entirely vaporizable by heat ; soluble in forty parts of a concentrated solution of chloride of sodium at 212° F., and again deposited in fine red crystals on cooling."

MERCURY, PEROXIDE OR RED OXIDE OF.

Hydrargyri Oxidum Rubrum, U. S.

This oxide has a brilliant red colour, a shining scaly appearance, an acrid taste, and is poisonous. It is very sparingly soluble in water. Its specific gravity is 11.074. When heated gently it turns black, but becomes again red on cooling. A strong heat decomposes it into oxygen gas and metallic mercury. The *Red Precipitate* of commerce is found in the form of round, thin, flattened masses, or in irregular morsels. These masses are composed of a multitude of little micaceous scales, which adhere very slightly. The scales are sometimes sufficiently large and brilliant to be easily distinguished, and sometimes the pieces have an earthy fracture, and exhibit the scales very indistinctly. The latter sort is less esteemed than the preceding ; its earthy appearance is a fault arising from defects in its mode of preparation.

Peroxide of mercury sometimes contains a little undecomposed nitrate of mercury, which in certain cases is exceedingly injurious. It is also adulterated with red lead, oxide of iron, brick dust, and occasionally with organic matters. To detect these impurities put the suspected powder into a small glass tube closed at one end, and expose it to heat until the peroxide of mercury is completely decomposed. If red lead is present the operation yields fused protoxide of lead. Peroxide of iron will remain in the form of a dark red powder in the bottom of the tube. Brick dust will also remain unchanged. If nitrate of mercury is present, red fumes will be seen in the glass tube soon after the first application of the heat, and a very pungent odour will be perceived when the tube is held near the nose. The presence of the same or some other saline impurity would also be proved should a solution of the suspected powder in boiling water give a precipitate with lime water. If vegetable substances are mixed with the peroxide of mercury, they will remain suspended when the powder is thrown into water; whereas the peroxide instantly sinks to the bottom.

The peroxide of mercury prepared by the decomposition of corrosive sublimate, is sometimes mixed with bichloride or oxichloride of mercury. Dissolve the suspected substance in nitric acid, and add nitrate of silver to the solution. If any bichloride is present it will cause a white precipitate, which darkens on exposure to light, and is soluble in ammonia.

MERCURY, PROTOCHLORIDE OF.

Hydrargyri Chloridum Mite, U. S.—*Calomel*.

This compound, when obtained by sublimation, occurs in a white, fibrous, crystalline mass, studded with shining, transparent crystals, having the shape of quadrangular

prisms. When finely powdered, it acquires a buff colour. As formed by precipitation, it is a white, tasteless, inodorous and insoluble powder. Its specific gravity is 7.20. When heated to redness, it rises in vapour without previous fusion. By a moderate heat it becomes yellow, but recovers its white colour on cooling. When rubbed with the alkalies, or alkaline earths, it becomes black, in consequence of the formation of protoxide.

Through carelessness in its preparation, calomel sometimes contains corrosive sublimate. This may be detected by heating a portion of the suspected calomel with eight or ten times its bulk of alcohol, and then adding to the alcoholic liquor some solution of ammonia, which causes a white precipitate if corrosive sublimate is present. The presence of chalk may be ascertained by the effervescence which follows the addition of a small quantity of very dilute muriatic acid, and the white precipitate produced in the clear neutral solution by oxalate of ammonia. To determine whether this is not caused by white lead, which may also be used as an adulterant, pass a stream of sulphuretted hydrogen through the filtered muriatic solution, when, if lead is present, a black precipitate will be produced. After the separation of the sulphuret by filtration, the clear solution may be tested for lime in the manner already pointed out. Nitrate of mercury may be detected by digesting the calomel in dilute nitric acid, and then adding potassa, when a red precipitate will be produced.

Calomel changes colour by exposure to the light; it should, therefore, be kept in a dark place, or in bottles painted black, or covered with black paper.

MERCURY, PROTOXIDE OR BLACK OXIDE OF.

Hydrargyri Oxidum Nigrum, U. S.

A dark grey or nearly black powder, insoluble in water and yet having a metallic taste. Its specific gravity is 10.69. When pure, it is entirely soluble in acetic and nitric acids, and entirely insoluble in muriatic acid which forms with it water and calomel. By a strong heat it is completely dissipated, and metallic mercury is sublimed.

Protoxide of mercury has a great tendency to resolve itself into peroxide of mercury and metallic mercury, and it is extremely difficult to procure it in a state of absolute purity. It is often adulterated, especially when in the form of the blue mass or of ointment, with lampblack, sulphur and other substances; and sometimes this ointment is almost wholly free from mercury. Such frauds may be detected by melting the ointment, or by warming it in very strong alcohol, or in ether, which dissolve the fat, and deposit the mercury, if present, or demonstrate its deficiency when absent.

The blue mass is sometimes prepared with conserve of roses, to which sulphuric acid has been added to heighten the colour; and it then contains subsulphate of mercury, which possesses very irritating properties. The presence of this salt may be detected by triturating the mass with boiling water and adding to the filtered liquor solution of nitrate of baryta; if any sulphate be present, a white precipitate, insoluble in nitric acid, will be produced.

If the protoxide of mercury is mixed with the peroxide, it may be detected by dissolving the suspected substance in muriatic acid and adding potassa to the filtered solution. A reddish or yellowish precipitate indicates the presence of the peroxide. Oxalate of ammonia added to this solution

will cause a white precipitate if the protoxide contains lime. Calomel, if present, may be detected by boiling the powder with a solution of potassa, which, when the solution is saturated with nitric acid, will give a precipitate of chloride of silver on the addition of the nitrate of that metal.

The presence of metallic mercury may be detected by the protoxide not being completely soluble in acetic acid.

MERCURY, RED SULPHURET OF.

Hydrargyri Sulphuretum Rubrum, U. S.—*Vermilion*—*Cinnabar*.

A well-known compound, which in the mass has a dark reddish brown crystalline appearance, but when reduced to powder is of a fine scarlet red colour, and is then called *Vermilion*. It is tasteless, inodorous, insoluble in water and alcohol, and permanent in the air. When subjected to heat, it becomes of a darker colour, fuses, and is entirely volatilized.

Vermilion is frequently adulterated. The most common substances employed for this purpose are, red lead, brick dust, dragon's blood and realgar. In order to detect these impurities, put a little of the suspected vermilion in a clean iron spoon, and expose it to heat. Treat the residue, if any, with nitric acid. Brick dust will remain, while the red lead, if present, will be dissolved. The solution will then give a black precipitate with sulphuretted hydrogen, a white one with sulphuric acid, and a yellow one with iodide of potassium. Dragon's blood gives a red tincture when the powder is digested in alcohol. Realgar, or sulphuret of arsenic, may be detected by boiling the suspected substance in solution of caustic potassa, supersaturating it with muriatic acid, and passing a current of sulphuretted hydrogen through the solution. If any arsenic is present a fine yellow precipitate will be produced, from which the metal may be obtained.

MERCURY, WHITE PRECIPITATE OF.

Hydrargyri Ammoniatum, U. S.

This compound is obtained when ammonia is added to a solution of corrosive sublimate. It occurs in masses or in powder, white, inodorous, having a taste at first earthy and afterwards metallic. It is decomposed and dissipated by heat, insoluble in alcohol, and thus distinguished from corrosive sublimate. It is soluble in the mineral acids, not altered by ammonia, and thus differing from calomel, which is blackened by that alkali.

This compound is largely adulterated with sulphate of lime. Pereira states that he has one sample containing one-third of its weight of this substance. Carbonates of lime and of lead are also sometimes employed as adulterants of white precipitate. Ignite the suspected substance strongly in a crucible; the white precipitate is volatilized without any residue, whereas the above impurities remain. Dissolve the residue in nitric acid; the carbonates are recognized by the effervescence. Add ammonia to the solution, and if a precipitate is formed, separate it by filtration, and moisten it by a solution of sulphuretted hydrogen; it will turn black if lead is present. If the filtered solution gives a white precipitate with oxalate of ammonia, it indicates the presence of lime. Sulphate of lime alone may be detected by boiling the suspected substance in distilled water, and adding, to separate portions of the filtered solution, chloride of barium and oxalate of ammonia. If sulphate of lime is present, the former should give a white precipitate, insoluble in nitric acid, and the latter, a white precipitate which is converted into carbonate of lime by a red heat. If starch is mixed with white precipitate, the nitric solution will form a blue precipitate with iodide of potassium; while the presence of protoxide of mercury is shown by its being blackened when rubbed with lime water.

MILK.

In large cities, where the consumption of milk is very great, it is seldom exposed for sale without having received some fraudulent addition. Although these adulterants are not always positively injurious, they at least diminish those qualities which render milk so valuable an article of food. Many of the frauds practiced with it in Paris and other European cities, have probably never been here introduced; but there are some facts in regard to this liquid which deserve to be noticed in a work of this kind.

Milk is a white opaque liquid, yielding about ten or twelve per cent. of solid matter on being evaporated to dryness by a steam heat. Its specific gravity is about 1.030. It is usually slightly acid, as may be shown by its reddening litmus paper; but occasionally it is alkaline. When diluted with water it presents a bluish colour, instead of that dull white, which is characteristic of the pure substance.

Various instruments have been invented for the purpose of determining in an easy and certain manner the comparative goodness of samples of milk. They are known by the names of *Lactometers*, *Creamometers*, *Galactometers*, and *Lactoscopes*. Some of these are similar in construction to the hydrometer, and their employment is founded upon the assumption that the specific gravity of milk is a true criterion of its richness and purity. But it is a serious objection to such instruments that the milk of different cows varies in its density, and that the food, the age and state of health of the animal also effect considerable changes in this respect. It is this variation in the specific gravity of pure milk which renders it difficult to detect even considerable additions of water. From the researches of Lassaigue it appears that mixtures of milk and water, in which the proportion of the latter is less than one-fourth or one-third, have a density not sufficiently reduced below the *minimum standard* of pure milk, to be determined by the lactometer.

The *Creamometer* consists of a glass tube about a foot long and half an inch in diameter, supported upon a foot. If milk is poured into such a tube and permitted to repose there, the cream which it contains rises to the surface and forms a cake, the bulk of which, when compared to the bulk of the milk, denotes the comparative goodness of the sample. The tube should be graduated into ten parts, and the two upper parts divided each into ten others. It is then easy to determine at a glance the *per centage* of cream contained in any sample of milk submitted to trial. It should be previously ascertained how many parts of cream are contained in one hundred parts of genuine new milk. Some hours are required to perform an experiment with this instrument, and this seems to be the principle objection to its general employment.

Among the adulterations of milk which have been noticed, are the addition of flour of various kinds, starch, white and yolk of eggs, gum arabic, dextrine, emulsions of various seeds, chalk, plaster of Paris, bicarbonate of soda, and even the cerebral matter of the sheep. Many of these may be easily detected, as flour and starch, by the blue colour which they give on the addition of the tincture of iodine. The presence of eggs may be ascertained by filtering the milk and then boiling the filtered liquor, when flocks of albumen more or less abundant will be formed. Gum arabic, unless added in large quantity, has very little effect upon the density of milk, but such addition is too expensive to be advantageously practiced. The taste of dextrine is too disagreeable to be employed as an adulterant. Chalk and plaster of Paris, if used, will subside upon setting aside the milk and can be then detected by the appropriate tests.

There is no doubt that these supposed adulterations have been greatly exaggerated, as most of the substances are easy of detection, and do not after all answer the purpose for which they are said to be employed. The frauds which are known to be extensively practiced with milk, are the removal

of the cream, dilution with water, and the addition of bicarbonate of soda to neutralize its acidity. I have already referred to the difficulty which attends the detection of water in milk unless added in the proportion of a fourth or a third part. The peculiar colour of such diluted milk would be a good test, if it were not that expert *manufacturers* add some colouring material, as annatto, the juice of the carrot, turmeric, &c., to conceal the change in this respect. The presence of bicarbonate of soda may be ascertained by its effervescence on the addition of an acid, as it is generally added in excess. Cases are referred to in which this salt has been used in such quantity as to cause the death of children who have used milk thus adulterated.—(*Garnier and Harel, Des Falsifications des Substances Alimentaires.*)

But the deterioration which milk suffers from other causes is equally worthy of consideration. I refer to the effects produced upon this liquid by the different influences to which the animal is subjected, as food, state of health, fatigue, &c. It is well known that various articles eaten by cows pass rapidly into the circulation and can be detected in the milk. Thus, milk has a yellow colour when cows eat the marsh marigold (*Caltha palustris*); a bitter taste, when they eat wormwood; and the strong taste and odour of garlick, when they pasture in fields where this plant is abundant. The purity and healthfulness of milk must, therefore, depend greatly upon the food with which cows are supplied. The diseases of these animals, whether induced by improper food or otherwise, must also have an important influence upon the quality of their milk. The remarkable milk sickness of the Western States affords a striking illustration of the correctness of these statements. It is not without reason, therefore, that the great mortality among children in Paris is ascribed chiefly to the bad quality of the milk with which such a large number are constantly fed. It is said that the cows whose milk is intended for infants, are kept in close and warm stables, for the purpose of increasing the quantity of

the liquid. But tubercles have been found in the lungs of almost all these cows in Paris and its vicinity.—(*Garnier and Harel.*)

MORPHINE OR MORPHIA.

Morphia, U. S.

One of the alkalies obtained from opium, and that in which the medicinal powers of this remarkable drug are supposed chiefly to reside. In its pure form it occurs in small, brilliant, colourless crystals. Although it has a very bitter taste, it is almost insoluble in cold water; boiling water does not dissolve more than 1-100th of its weight. It dissolves in 40 parts of cold and 30 parts of boiling alcohol. It is almost insoluble in ether, and it may thus be distinguished and separated from narcotine, which is very soluble in that menstruum. Morphine and its salts strike a deep blue with a *neutral* solution of sesquichloride of iron. They likewise decompose iodic acid and liberate iodine, which may then be detected by the blue colour produced upon the addition of starch. These tests will distinguish morphine from brucine; both of which, on being treated with nitric acid, assume an orange red colour which afterwards passes into yellow. The nitric solution of brucine, however, is changed to a violet upon the addition of protochloride of tin, which is not the case with that of morphine.

MORPHINE, ACETATE OF.

Morphiæ Acetas, U. S.

When pure, this salt is in distinct, snow-white crystals; but as ordinarily obtained, it is in the form of a greyish white powder. It is inodorous, but when moistened emits a feeble odour of acetic acid. It has an intensely bitter taste; very soluble in water and in alcohol.

Acetate of morphine readily undergoes decomposition; and, as met with in commerce, is a mixture of morphine, neutral acetate and superacetate of morphine. It is there-

fore imperfectly soluble, unless a few drops of acetic acid be added. The Edinburgh College gives the following characters of its purity: "One hundred measures of a solution of ten grains in half a fluid ounce of water and five minims of acetic acid, heated to 212° , and decomposed by a faint excess of ammonia, yield by agitation a precipitate which, in twenty-four hours, occupies 15.5 measures of the liquid.

MORPHINE, MURIATE OF.

Morphiæ Hydrochloras, U. S.

This salt occurs in colourless, plumose, needle-form crystals. It is destitute of odour, has a very bitter taste, is soluble in from ten to twenty parts of cold, and in less than its own weight of boiling, water; soluble also in alcohol.

Muriate of morphine is apt to contain an undue quantity of colouring matter and moisture. White powders may also be added as adulterants. The tests of the Edinburgh College seem to afford the means of detecting these impurities. They are as follows: "Snow-white; entirely soluble; solution colourless; loss of weight at 212° not above 13 per cent.; one hundred measures of a solution of ten grains in half a fluid ounce of water heated to near 212° , and decomposed with agitation by a faint excess of ammonia, yield a precipitate which, in twenty-four hours, occupies 12.5 measures of the liquid."

MORPHINE, SULPHATE OF.

Morphiæ Sulphas, U. S.

It occurs in white, minute, feathery crystals, which are soluble in about twice their weight of water.

Sometimes this salt, as it is found in the shops, either from faulty preparation or from some adulteration, is not entirely soluble in water. This may be owing to the presence of a little uncombined morphine, in which case the complete so-

lution is effected by the addition of a little sulpeuric acid to the water.

MURIATIC ACID.

Acidum Muriaticum, U. S.—*Hydrochloric Acid*.

This acid usually occurs in the form of an aqueous solution, which, in its highest degree of concentration, has a specific gravity of 1.21; but the acid of commerce is seldom above 1.17. When pure, it is colourless, evolves white fumes in the air, and has the odour and taste of the gaseous acid. With nitrate of silver it yields a dense white precipitate, which is insoluble in nitric acid, soluble in ammonia, and blackens on exposure to light.

Muriatic acid, as it occurs in commerce, is often adulterated with sulphuric, nitric, and sulphurous acids, chloride of iron, chloride of sodium, &c. If sulphuric acid be present, a solution of chloride of barium, added to a dilute solution of the suspected acid, will cause a white precipitate insoluble in nitric acid. When muriatic acid contains chlorine, it is deprived of its yellow colour by heat, by exposure to light, and by neutralization with ammonia. The presence of chlorine may also be proved by the acid having the power to dissolve gold leaf. Nitric acid may be detected by the rose or purple colour which is developed upon the addition of a crystal, or strong solution of, protosulphate of iron. The presence of sulphurous acid may be shown by adding to the suspected acid a portion of protochloride of tin, and after a short interval mixing the whole with two or three times its bulk of distilled water. The sulphurous acid is deoxidized by the salt of tin, and affords a beautiful yellow precipitate consisting of sulphur and peroxide of tin. On the addition of water to this mixture the odour of sulphuretted hydrogen will be distinguished, the liquid will become of a brown tint and deposit a powder of the same colour. Iron, if present, may be detected by the blue col-

our-produced upon adding ferrocyanide of potassium to a portion of the diluted acid saturated with ammonia. A current of sulphuretted hydrogen, passed through a portion of the acid diluted with an equal weight of water, will cause a black precipitate if the muriatic acid contains lead; and if arsenic is present, which is occasionally the case, it will be thrown down by this test in the form of the yellow sulphuret of that metal.

The quantity of real acid contained in solutions of different densities, may be determined by ascertaining the quantity of pure marble dissolved in a given weight of each. Every 50 grains of marble correspond to about 37 of real acid.

MUSHROOMS.

A great number of fungi of a poisonous nature bear so close a resemblance to the mild, eatable mushroom, as often to deceive the best judges. The following description of the true mushroom may, therefore, be useful to those who wish to employ this vegetable as an article of food. The *gills*, or under part of the cap, are loose; of a pinky-red changing to a liver colour; situated close to the stem, but not united to it; very thick set, irregularly disposed, some forked next the stem, some next the edge of the cap, and some at both ends, in which case the intermediate smaller gills are generally excluded. The cap or *pileus* is externally white, changing to brown when old, and becoming scurfy; it is regularly convex, fleshy, flatter when old, from two to four inches, but sometimes even nine inches in diameter; it liquefies as it decays; the flesh is white. The *stem* is solid, white, cylindrical, from two to three inches high, half an inch in diameter. The *curtain* or membrane which extends from the stem to the edge of the cap is white and delicate.

The false or poisonous mushrooms have a warty cap, or

else fragments of membrane adhering to the upper surface ; they are heavy ; they emerge from a *vulva* or bag ; they grow in woods and shady places, or in tufts or clusters on the trunks or stumps of trees ; have an astringent or styptic taste, and a pungent and often nauseous odour ; become blue after being cut ; are moist on the surface ; have an orange or rose-red colour, and turn yellow when salted ; while the eatable ones turn black. This last is one of the best modes of distinguishing between the eatable and poisonous kinds. The salt should be allowed to act some time before you decide as to the colour.—(*Domestic Chemist.*)

MUSK.

Moschus, U. S.

This remarkable substance appears to be a peculiar secretion deposited in a small sac situated near the umbilicus of the male of the *Moschus moschiferus* Gmelin, or Musk-deer, an animal inhabiting the elevated regions of Central and Eastern Asia. Musk comes to us in sacs convex and covered with hair on one side, and flat and destitute of hair on the other. It is in grains or lumps concreted together, soft and unctuous to the touch, and of a reddish brown colour. The odour is very powerful ; taste bitter, disagreeable and somewhat acrid. It is inflammable, burning with a white flame, and leaving a light spongy charcoal.

Two distinct kinds of musk are known in commerce ; the first being the Chinese Tonquin, Thibetian, or Oriental, and the second, the Siberian or Russian. The Chinese is considered by Dr. Goebel as the result of ingenious adulterations. The bags from that country are found invariably to have been opened and again glued together more or less neatly ; though sometimes the stitches of the sewing are more or less manifest. They often contain dried blood, animal membrane, sand, iron filings and various other adulterations, the pres-

ence of which may in general be detected, by the feeble odour, gritty feel and want of combustibility of their contents. If the bags have been opened and reclosed, it can be determined either by a close inspection or by dipping them in hot water. The Russian musk is said to be genuine ; the bags never being opened, are consequently never sewn, nor artificially closed like those imported from China. The interior mass is often of a soft and pappy consistence ; but the surface of the bag is perfectly dry.

MUSTARD.

Sinapis, U. S.

The black and white mustards of commerce are the seeds of the *Sinapis nigra* L. and *S. alba* L., which are grown in various countries. The strongest mustard gives a powder which has a greenish yellow colour, but which is intermingled with black points arising from the presence of the pulverized shell of the seed. The pale yellow and weak powder often loses its colour on being kept. It is sometimes coloured with turmeric or yellow ochre ; and various other farinas are often mixed with mustard powder. The presence of turmeric can be determined by the addition of a few drops of a solution of potassa or ammonia, which changes the colour to brown, while it has no action on the colour of mustard. The presence of ochre may be determined by incinerating the suspected powder, when the ochre will be left. Barley and maize flour, often added to mustard, can sometimes be detected by solution in boiling water, and the addition of tincture of iodine when it has become cold. A violet or blue colour will be produced if these farinas are present. Moreover, when mustard is largely adulterated in this way, it forms a tenacious paste with water, which is not so striking when the mustard powder is pure.

The bright yellow powder sold under the name of *flour of mustard*, is generally a compound of black and pale mustard-seed, Cayenne pepper, wheat flour and turmeric.— (*Domestic Chemist.*)

MYROXYLON.—See BALSAM OF PERU.

MYRRH.

Myrrha, U. S.

This is the concrete juice of the *Balsamodendron Myrrha* *Nees Von Esenbeck*, a small tree growing in Arabia Felix, whence it is taken to the East Indies. It occurs in small irregular fragments or tears; or in larger masses, composed of portions of an irregular shape and varying in their shade of colour. When pure, myrrh is reddish yellow or reddish brown and translucent, of a strong somewhat peculiar odour and a little aromatic taste. Its powder has a light yellowish colour. Its specific gravity is said to be 1.36. It is inflammable, but does not burn vigorously, and is not fusible by heat. A few drops of nitric acid dropped on a fragment of myrrh developes a red colour.

The inferior kinds of myrrh, commonly called *India Myrrh*, are in pieces much darker than those above described, and contain many impurities. Pieces of *India Myrrh* sometimes enclose "large crystals of common salt, as if the juice might have fallen from the tree and concreted upon the ground, where this mineral abounds. Pieces of *bdellium* and other gummy or resinous substances of unknown origin are often mixed with it. It is best to purchase myrrh in mass; as in powder it is very liable to adulterations which are not easily detected."—(*U. S. Dispensatory.*)

According to M. Righini the purity of myrrh may be determined by finely pulverizing and saturating it for a quarter of an hour, with an equal weight of sal-ammoniac in pow-

der, and then adding gradually fifteen times its weight of water. If the mixed powder dissolve quickly and entirely, the myrrh is pure.—(*The Chemist*, Oct., 1845.)

NAPHTHA OR ROCK OIL.

A variety of bitumen occurring in some parts of Italy, and on the banks of the Caspian Sea, and produced also by distillation from petroleum. It is a volatile, limpid liquid, having a strong peculiar odour and light yellow colour. Specific gravity, when highly rectified, 0.753 at 61°. It is very inflammable, and burns with a white flame mixed with much smoke. When adulterated with oil of turpentine, as is sometimes the case, it becomes thick and reddish brown on being agitated in contact with strong sulphuric acid.

NITRIC ACID.

Acidum Nitricum, U. S.

When perfectly pure, nitric acid is a colourless liquid, having a specific gravity of 1.52. But as it commonly occurs, it contains nitrous acid which gives it a yellow colour. Such acid becomes colourless when diluted with water. The nitric acid of commerce also often contains both sulphuric and muriatic acids; the former being derived from the acid used in the process; the latter, from the common salt which is sometimes mixed with the nitre. These impurities can be detected by adding a few drops of a solution of chloride of barium and of nitrate of silver to separate portions of the nitric acid diluted with four or five parts of distilled water. If the solution of chloride of barium causes a cloudiness or precipitate, sulphuric acid is present; if a similar effect is produced by nitrate of silver, the presence of muriatic acid may be inferred.

Nitric acid sometimes contains iodine from the nitrate of

soda now used in the manufacture. Its presence may be detected by saturating the acid with soda, and then adding starch and sulphuric acid. A blue compound will be produced if iodine is present.

If nitric acid, when evaporated on a watch glass, leaves a residue, it may contain nitrate of potassa or oxalic acid. If the presence of a metal is suspected, it may be detected by neutralizing the acid with ammonia, and afterwards treating it with solution of sulphuretted hydrogen or hydrosulphuret of ammonia. Should a precipitate be formed a metal is present.

The nitric acid of commerce (*Aqua fortis*) has generally a specific gravity of 1.31. When it is lighter than this, it is diluted with water; when it is heavier, it generally contains saltpetre or sulphuric acid.

NITROGEN, PROTOXIDE OF.

Exhilarating Gas.

As this gas, in consequence of its singular effects upon the animal economy, is frequently breathed, it may not be amiss to notice some of the adulterations which may be productive of injurious and even fatal effects. If the temperature applied to the nitrate of ammonia, from which this gas is usually obtained, is allowed to rise too high, the ebullition becomes tumultuous, and the flask or retort is filled with white fumes which have an irritating odour, and the gas which then comes off is little more than nitrogen. This gas is also sometimes contaminated with nitrous acid vapour, and a case is related of a young man who was poisoned in this manner. He continued ill for two days, and was relieved by cold affusions over the head, and bleeding from the temporal artery.—(*The Chemist*, iv., 85.) The presence of this acid is detected by the appearance of red fumes on mixing it with oxygen. If the nitrate of ammonia contains

a mixture of the muriate, the gas will be contaminated by chlorine. The presence of the latter is ascertained by the smell, and by the white precipitate which the solution of the nitrate of ammonia gives with solution of nitrate of silver.

NITROMURIATIC ACID.

Acidum Nitromuriaticum, U. S.—*Aqua Regia*.

This is a mixture of one part of nitric acid, and two parts of muriatic acid, by measure. It has a yellow colour and possesses the property of dissolving gold and platinum, metals which are insoluble either in nitric or muriatic acid separately. It should be kept in a cool, dark place, for heat expels the chlorine; while under the influence of light it decomposes water and forms muriatic acid.

NITROUS OR HYPONITROUS ETHER.

Æther Nitrosus, D.

This is a very volatile liquid of a pale yellow colour, having an agreeable odour and a specific gravity, when pure, of 0.947, at 60° F. It is soluble in about 48 parts of water, and in all proportions in alcohol or rectified spirit. It boils at 62°; is highly inflammable, burning with a white flame without residue.

The impure ether obtained by the ordinary processes boils at 70°, and has a specific gravity of 0.886 at 40°. Mixed with an alcoholic solution of potassa it assumes a dark brown colour, owing to the presence of aldehyd. By keeping, it gradually becomes acid, as is shown by its effect upon litmus paper; and nitric oxide is given off, which often causes the bursting of the bottle. This tendency to acidify is greatly increased by the action of the air, and by heat. It should therefore be kept in a cool place, and in small, strong bottles, entirely full.

Sweet Spirit of Nitre, (*Spiritus Ætheri Nitrici*. U. S.) is a mixture of nitrous ether and alcohol in variable proportions. It is a colourless volatile liquid, with a fragrant ethereal odour and a pungent, aromatic, sweetish taste. It boils at about 160° , is very inflammable and burns with a whitish flame. Its specific gravity is 0.834 U. S., to 0.847 Ed. It generally reddens litmus slightly, but when perfectly pure should be without any acid reaction, and should volatilize without leaving the slightest residue.

This article is very extensively adulterated. Wholesale dealers usually keep two, or even three, qualities of this preparation: the inferior ones being obtained by diluting the best with different quantities of water, or spirit of wine and water. "Some years since large quantities of spirit of wine, flavored with hyponitrous ether, were imported into London, under the name of spirit of nitric ether, in order to evade the duty payable on it as spirit of wine."—(*Pereira*.) The extent of this mixture can sometimes be determined by its specific gravity, but at others it is a fallacious criterion.

Sweet spirit of nitre often contains acetic acid or some of the acids of nitrogen in such quantity, as to redden litmus strongly and to cause an effervescence when added to carbonate of potassa. If a deep olive colour is produced with the protosulphate of iron, it indicates the presence of a nitrogen acid. The presence of these acids increases the specific gravity of the sweet spirit of nitre; but the addition of hyponitrous ether produces the same effect. A specific gravity lower than the U. S. standard would probably show that the alcohol is stronger than it should be, and either in the proper amount or in too large proportion.

When the specific gravity of sweet spirit of nitre is as high as that assigned by the Edinburgh College, the fraudulent addition of water and alcohol may be detected by agitating it with twice its volume of a concentrated solution

of chloride of calcium. If the article is of full strength, twelve per cent. of ether will slowly separate, which is twelve-twentieths of the quantity present. If less ether separates, it shows the presence of too much water and alcohol. This test, however, is said not to be applicable to the U. S. preparation.—(*U. S. Dispensatory.*)

NUTMEG AND MACE.

Myristica, U. S.

The fruit of the *Myristica moschata* Thunb., a beautiful tree growing in the Molucca Islands. The entire fruit is a species of drupe of an ovoid form, about as large as a peach, and marked with a longitudinal furrow. The nutmeg is the innermost kernel or seed, contained in a thin shell, which is surrounded by a many-cleft aril called *Mace*. It is of a roundish or oval shape, obtuse at the extremities, marked with vermicular furrows, of a greyish colour, yielding readily to the knife or grater. It has a very fragrant odour, a warm and aromatic taste; it yields its virtues to alcohol and ether.

Good nutmegs should be dense and feel heavy in the hand; they should not be musty or marked with black veins. When they have been perforated for the purpose of extracting the oil, or by worms, they feel light, and though the holes have been closed, the unsound ones may be detected by this test. The fruit of the *Myristica tomentosa* Thunb. is sometimes fraudulently mixed with the common nutmeg; but it contains much less oil and is less aromatic. Mace, as it is found in the shops, is a flat, smooth, irregularly slit and brittle membrane, of a pale cinnamon yellow colour and an odour and taste quite similar to those of nutmeg. The inferior kind is brittle, has a paler colour and little taste or smell.

There is an article in the shops known by the name of

Expressed Oil of Mace, or Butter of Nutmegs. It is imported in oblong cakes, of an orange colour, a firm consistence and a fragrant odour. The best kind is brought from the East Indies. An artificial preparation is substituted for it which consists of suet, palm oil, spermaceti, wax, &c., with some colouring substance, and a little volatile oil of nutmeg, to give it the genuine flavour. This fraud may be detected by the insolubility of this mixture in four parts of boiling alcohol.

NUX VOMICA.—See STRYCHNINE.

OILS, ESSENTIAL OR VOLATILE.

These oils are so named from their solubility in alcohol, such solutions being called *Essences*, and from their volatility. It is in consequence of this last property that they are usually obtained by the distillation of plants or parts of plants which contain them, with water. They have a penetrating odour and taste, are for the most part soluble in alcohol, and very sparingly soluble in water. They are very inflammable, and burn in the air with a clear white light. As many of them bear a high price, they are often largely adulterated. The following are some of the substances employed for this purpose :

1. *Fixed Oils, Resins and Balsam of Copaiba.*—To detect these substances pour a little of the oil upon paper and evaporate by a gentle heat. Pure volatile oil flies off without leaving any residue, but the adulterated oil leaves a semi-transparent stain upon the paper. When the adulterated volatile oil contains fixed oil, the latter is detected by shaking the volatile oil with three times its bulk of alcohol, of the specific gravity of 0.84, in which the volatile oil dissolves, but the fixed oil remains undissolved. A portion of the balsam of copaiba, if any is present, remains also undissolved. To separate the resin the volatile oil must be

distilled with water. When oil of turpentine is used as an adulterant, it may be known by its remaining in part undissolved when treated with alcohol of the above strength. When costly oils are mixed with those of less value, the taste and smell afford the best means of detecting the fraud.

2. *Spirit of Wine*.—The volatile oils are sometimes adulterated with spirit of wine. The following plan has been proposed for detecting this substance: Add to the suspected oil an equal quantity of pure olive oil or oil of almonds. If alcohol is present, it separates as water does from the fixed oils with which they have been mixed. It is also detected by shaking the oil with water in a graduated glass tube. The liquid becomes milky, and after it has settled, and the oil and water have separated, the oil is found to have diminished in bulk and the water to have increased. The loss of bulk of the oil indicates the extent of the adulteration. Another test consists in introducing, in small pieces, well dried chloride of calcium into a cylindrical tube closed at one end, and about two-thirds filled with the oil to be examined, heating the tube to 212° and occasionally shaking it. If there is a considerable proportion of alcohol, the chloride is entirely dissolved, forming a solution which sinks to the bottom of the tube; if only a very small quantity, the pieces lose their form and collect at the bottom in a white adhering mass; if none at all, they remain unchanged.

Volatile oils should be kept in well-closed bottles entirely excluded from the light.

DISTILLED WATERS.—It is stated by Mr. Warrington that the distilled waters of our pharmacopœias, prepared by adding proof spirit to the essential oils and subsequent distillation, are changed into acetic acid, the change being complete in the course of twelve months. But when the essen-

tial oils are distilled with water without the addition of any spirit, not the least change occurred even at the expiration of a year. The addition of alcohol to these waters was originally adopted in order to prevent them from becoming mucilaginous and sour, but from these experiments it is found to produce a directly contrary effect.—(*Phil. Mag.*, xxvi., 474.)

OLIVE OIL.

Oleum Olivæ, U. S.

This is the expressed oil of the fruit of the *Olea Europæa* L., a native of Asia Minor, and cultivated all over the south of Europe. Several varieties occur in commerce. The purest kind is an unctuous, transparent fluid, of a pale yellow or greenish yellow colour. It is almost without odour and has a bland and mild taste. Its specific gravity at 77° F. is 0.910. It is soluble in about one and a half times its weight of ether, but is only slightly so in alcohol. At 38° F. it begins to congeal.

Olive oil is less liable to alteration than most of the other oils; but when carelessly prepared it soon becomes rancid, and then acquires a disagreeable odour and a nauseous taste.

The adulteration of olive oil is said to be extensively practiced. Poppy oil, as it is much cheaper and does not sensibly change the taste of olive oil, is commonly employed for this purpose. Several modes have been suggested for detecting this fraud. The most simple one is to shake a bottle half filled with the suspected oil. If pure, the surface of the oil soon becomes smooth by repose; but if poppy oil is present a number of air bubbles, or *beads* as they are called, remain. Olive oil congeals perfectly when plunged into pounded ice; but when poppy oil is present it remains in part liquid. A mixture of two parts of olive oil and one of poppy oil does not congeal at all.

A more certain test of the purity of olive oil is founded upon the fact that the hyponitrous acid causes the solidification of the fat oils, but that the time required for the solidification differs in each oil. M. Boudet has ascertained that half a grain of hyponitrous acid, mixed with three times its weight of nitric acid, solidified 100 grains of olive oil in about 78 minutes. He has also found that it is easy to determine the presence of poppy oil in olive oil by the slowness with which the mixture solidifies with hyponitrous acid. One per cent. of poppy oil retards the solidification not less than forty minutes.

Another, but somewhat similar test, has been introduced by M. Poutet. It consists in strongly agitating the suspected oil with one-twelfth of its weight of a supernitrate of mercury, prepared by dissolving six parts of mercury in seven and a half of nitric acid of the specific gravity of 1.38. The reagent must be employed as soon as the mercury is dissolved; if the salt is allowed to crystallize it is useless. If the oil is pure it is converted, after some hours, into a yellow solid mass; if it contain so small a proportion as a twentieth of poppy oil, the resulting mass is less firm; the difference, however, is not always sufficiently marked. But a mixture of one-tenth of poppy oil prevents a greater degree of consistence than oils acquire by being subjected to a low temperature. For all practical purposes this degree of sensibility is sufficient, as below this proportion there is little to be gained by the adulteration.

Olive oil is sometimes mixed with fatty semi-solid matters, in order to give it the appearance of good oil which concretes by cold. Sometimes, also, olive oil is mixed with honey. When treated with hot water the aqueous and oleaginous liquids separate. The presence of honey may then be determined by the evaporation of the former.

OPIUM.

Opium, U. S.

This is the name given to the inspissated juice which flows from incisions made in the unripe capsules of the *Papaver somniferum* L. It is only effectively obtained in warm climates, and the chief supply is procured from Turkey and India. It is a very heterogeneous compound, consisting of at least a dozen proximate principles, of which the most important are, *Morphine*, *Narcotine* and *Codeine*.

Several varieties of this drug are described by writers on the Materia Medica. Our market, however, is almost exclusively supplied with the *Turkey Opium*, which is chiefly shipped from the port of Smyrna, and hence often called *Smyrna Opium*. It occurs in irregular masses, more or less flattened, covered with pieces of the dried leaves and with the reddish winged capsules of some species of *Rumex*, and sometimes also with poppy leaves. It has a rich reddish brown or fawn colour, a waxy lustre when cut, a tough consistence and a tolerably compact texture. Its odour is heavy, strong and narcotic ; its taste bitter, acrid and nauseous.

There is no article in which frauds have been more extensively practiced than in opium. Even of the Turkey opium, the best kind in market, one-fourth part generally consists of impurities. Among the substances employed as adulterants are, the extracts of the poppy, lettuce, and liquorice, gum Arabic, gum tragacanth, aloes, the seeds of different plants, sand, ashes, small stones and pieces of lead. An Armenian, who had been for many years engaged in the extraction of opium, informed Mr. Landerer, of Athens, that not a single cake of opium comes from the East without having been mixed in the soft and fresh state with grapes freed from their seeds and crushed. Another adulteration was said to con-

sist of the epidermis of the capsules and stalks of the poppy, pounded in a mortar, and mixed with white of egg.—(*The Chemist*, Sept., 1843.) Some samples of opium, also, which are apparently pure, are found to be totally destitute of the active principle of this drug.

It is by no means easy, except by actual trial upon the system, to determine the quality of a sample of opium. The proportion of water may be judged of by the consistence, or, more accurately, by the loss on drying of a given weight of the drug. Many of the other impurities may be detected by a careful inspection. But the only certain test of the goodness of opium is to ascertain the proportion of morphine which it contains. This can only be accurately done by carefully following out some of the processes for the preparation of morphine. A pound of good opium should yield about a sixteenth of its weight of this alkali.—(See *Graham's Chemistry*.)

OXALIC ACID.

This acid exists in the juice of several plants, as in that of the *Rumea acetosa* L., *Oxalis Acetosella* L., and the varieties of Rhubarb. It is also obtained artificially by the digestion of sugar in five or six times its weight of nitric acid. It usually occurs crystallized in slender flattened four-sided prisms, with two-sided summits; it has a very acrid taste; reddens litmus strongly; is soluble in nine parts of water at 60° and in its own weight of boiling water, also in four parts of alcohol. At a red heat it is decomposed, and if it leaves a fixed residue on ignition it is owing to some impurity. Its crystals should be colourless, and their solution should not give a precipitate with salts of baryta, or they contain sulphuric acid. They sometimes have a yellowish colour, a nitrous odour, and the property of corroding corks and paper, owing to the presence of a little nitric acid. Oxalic acid must be preserved in the form of a powder, as it soon

decomposes in solution. It may be purified by repeated crystallizations.—See APPENDIX.

PALM OIL.

This is a solid oil, or butter, obtained by pressure from the kernel of the fruit of the *Eläis guineensis* Jacq., a native of Guinea and Senegal, and also from various species of *Cocos*, as *C. nucifera* L., *C. oleracea* Mart., &c. It has the odour of violets, a sweet taste and an orange colour. It is lighter than water, melts at 84° F.; becomes rancid and pale by exposure to the atmosphere.

An imitation of this oil is made by mixing yellow wax and lard or lard oil flavoured with iris and coloured with turmeric. This mixture may be distinguished from the real palm oil, by its undergoing no change in colour by exposure to the air, and by its want of solubility in acetic ether.—(*Dumas, Chimie Appliquée aux Arts.*)

PEPPER, BLACK.

Piper Nigrum, U. S.

This is the produce of the *Piper nigrum* L., a plant cultivated in various parts of the East, as in Java, Sumatra, Borneo and the Philippine Islands. There are two sorts, the *black* and the *white* pepper, which are the produce of the same plant. The former is the fruit entire, the pericarp being allowed to dry on the seed. The white is obtained by steeping the black pepper in warm water and rubbing off the pericarps; by this means it loses much of its pungency.

Pepper should never be purchased in powder, because in this state it is almost always adulterated with foreign substances.

A fraud which is sometimes perpetrated, is to add to the pulverized pepper sold at retail, a certain portion of pulverized hemp seed. This powder after a certain time, gives to the pepper a disagreeable musty odour.

A case of some interest in connexion with the adulteration of white pepper, recently occurred in London, the particulars of which are given by Dr. Ure. A quantity of ground pepper belonging to an eminent spice house in that city had been seized by the excise on the charge of its being adulterated, or mixed with some foreign matter, contrary to law. Two chemists, on examination of the said pepper, asserted that it contained fully ten per cent. of sago, grounding their judgment on the appearance of certain rounded particles in the pepper, and of the deep blue colour which they assumed when moistured with tincture of iodine. It was afterwards ascertained that genuine white pepper acquires as deep a tint with iodine as any species of starch whatever. The analysis of a sample of this pepper yielded nearly the same results as that of genuine white pepper corns: the rounded particles seemed to be amorphous bits of grey clay.

Four pounds of black pepper yield about one ounce of *Piperine*, or one 636th part. It is an insipid crystalline substance, insoluble in water, but very soluble in boiling alcohol, and is extracted at first along with resin, which may be separated from it afterwards by potassa.—(*Ure's Dictionary of Arts, &c. Suppl.*)

PERUVIAN BARK.

Under this general term are included the barks of various species of *Cinchona*, among which may be enumerated, as those of most frequent occurrence in market, the *Cinchona Calisaya*, or *Yellow bark*, *Cinchona rubra*, or *Red bark*, and the *Cinchona corona*, or *Pale bark*. Besides these there are several other kinds, but there is still much uncertainty in regard to their true botanical characters. It is well known, however, that their medicinal powers depend upon the alkaline principles which they contain. The most remarkable of these is *Quinine* or *Quinia*, the salts of which have almost entirely superseded the use of the powdered barks.

Of this active principle the different varieties of Cinchona are known to yield very different proportions, and upon this circumstance their relative value depends.

The frauds that are practised with reference to Cinchona bark principally consist in the substitution of the inferior true barks for the finer kinds; the admixture of bark which has been exhausted by successive macerations and then dried, with good bark; and the substitution of spurious Cinchona barks for the true one. Of the false barks, three in particular have been described, viz.: Piton bark, Caribean bark and Pitaya bark. They have all a disagreeable, bitter taste, not aromatic. The other adulterations, however, are very difficult of detection, as it is almost impossible to judge of the quality of bark (especially if in powder) by its physical properties. The quality of the yellow bark is best determined by the proportion of quinine which it yields. As the process employed is difficult of application on a small scale, the Edinburgh College has given the following test, by which the greater part of the alkali contained in a sample can be readily procured in an impure state: A filtered decoction of one hundred grains in two fluid ounces of distilled water gives, with one ounce of concentrated solution of carbonate of soda, a precipitate, which, when heated in the fluid, becomes a fused mass, weighing when cold two grains or more, and easily soluble in solution of oxalic acid. Manufacturers of disulphate of quinine generally, however, employ the test proposed by Guibourt, by which the quantity of lime contained in a sample is determined, it having been ascertained that those barks which are most rich in quinine also contain most lime. The process is as follows: "Mix the bark in fine powder with water so as to form it into a fine paste; place this on paper, filter and add sulphate of soda to the filtered liquor as long as the white sulphate of lime is precipitated."—(*Neligan.*) See also the article QUININE.

PHLORIDZIN OR PHLORIZIN.

This substance, which very much resembles salicin, and promises to be a medicinal agent of much importance, is obtained from the bark of the roots of the apple, pear, cherry and plum tree. It crystallizes in colourless, silky prisms, having a bitter astringent taste. It has neither acid nor alkaline reaction, is soluble in 1,000 parts of cold water, and in all proportions of boiling water, very soluble in alcohol, but almost insoluble in ether. In its ordinary state it contains about seven per cent. of water. It fuses at 320° F., and at 392° F. is decomposed. In acetate of lead, it produces a white precipitate.

Phloridzin may be distinguished from salicin by its not yielding a red solution with sulphuric acid. When moistened with ammonia and exposed to the air, it absorbs oxygen and becomes blue, and if then dissolved in ammonia, the solution yields a red powder on the addition of acids.

PHOSPHORIC ACID.

Acidum Phosphoricum Dilutum, L.

This acid is used in the laboratory, and in a dilute form, in medicine. It is, when pure, a white flaky substance with an intensely sour taste, and it deliquesces on exposure to the air. The aqueous solution, prepared according to the directions of the London Pharmacopœia, is a colourless, inodorous liquid, possessing the usual properties of an acid. Its specific gravity is 1.064. When saturated with soda so as to form a soluble phosphate, it may be distinguished from all other acids by causing white precipitates with the soluble salts of lime, lead and baryta which are soluble in nitric acid, and by giving a yellow precipitate with nitrate of silver, soluble in nitric acid and in ammonia.

The injurious effects which sometimes follow the administration of phosphoric acid have been ascribed to the presence of phosphorous and arsenious acids in some specimens. In the case of phosphorous acid the peculiar action is supposed to be owing to the developement of a highly poisonous compound, phosphuretted hydrogen; for phosphorous acid, on being heated in the air, disengages a certain quantity of this gas.—(*The Chemist*, Feb., 1845.) The presence of sulphuric acid may be determined by the white precipitate, insoluble in nitric acid, produced by the addition of a solution of chloride of barium. The presence of phosphorous acid may be detected by introducing the suspected acid, along with zinc and dilute sulphuric acid, into a Marsh's apparatus. If phosphorous acid is present, phosphuretted hydrogen is formed, which may be detected by its smell; and if the gas is fired, it burns with a whitish brilliant flame, very different from that of pure hydrogen gas. Arsenious acid may be detected by the yellow precipitate produced by a current of sulphuretted hydrogen gas.

Phosphoric acid may also contain one or other of the common acids. If chloride of barium or nitrate of silver causes white precipitates insoluble in nitric acid, we infer in the former case, the presence of sulphuric acid, and in the latter, of muriatic acid. If strips of copper and silver are acted upon by it, the presence of nitric acid may be suspected. If carbonate of soda causes a precipitate, the phosphoric acid holds in solution some earthy phosphate.

PHOSPHORUS.

This well-known substance occurs in the form of small cylinders, which, when pure, are semi-transparent, or only slightly covered with a whitish coat. It is very easily cut with a knife, and the cut surface has a waxy lustre. Sometimes, however, it is brittle, owing to the presence of a small quantity of sulphur. If it has a reddish brown colour, it is

owing to the mixture of phosphuret of carbon, which is generally formed during the process of manufacture. Light also causes it to assume a red tint, and hence it should be kept in bottles, covered with dark paper, or enclosed in a tin case. It sometimes becomes almost entirely black.

PLATINUM.

This metal has a white colour very much like silver, but of inferior lustre. It has a specific gravity of 21.53, being the heaviest metal known, except iridium. It is soft, and, like iron, admits of being welded at a high temperature. It may be subjected to the strongest heat of a wind furnace without undergoing any change, and is not attacked by any single acid. These characters will serve to distinguish it from other metals which it resembles. Bubbles are sometimes found in platinum vessels which cause their destruction. This has been attributed to the presence of arsenic; but from some recent investigations it appears that the purest platinum is liable to this inconvenience, and that it is owing to a want of care in the forging. Rubbing a platinum vessel with charcoal powder is the most effectual method of removing stains.

Sometimes the injury done to platinum vessels, through carelessness, is incorrectly ascribed to impurities in the metal. Berzelius gives the following directions in regard to their employment: 1. They must not be subjected to the action of compounds which evolve chlorine. 2. Nitre and the alkalies must not be fused in them. 3. No metallic reductions must be performed in them; nor compounds of phosphorus decomposed so as to evolve that substance. 4. When metallic oxides are heated in a platinum crucible, the heat must not be raised beyond redness, provided the oxide is easily decomposed; hence, the caution requisite with the oxides of lead, bismuth, copper, cobalt, nickel and antimony, which, though they may not effect the fusion of the crucible,

spoil it by their action upon its interior surface, which is rendered rough and porous. 5. That the immediate contact of the fuel (charcoal should always be used) with the crucible should be avoided as much as possible, especially at very high temperatures; for it is thus, in the process of time, rendered brittle and unsound. Small holes and fissures may be filled up and soldered with pure gold, but in that case the vessel must not be exposed to a white heat, because then the gold and platinum combine.

POMEGRANATE BARK.

Granati Radix, E.

The bark of the root of the *Punica granatum* L., a native of the shores of the Mediterranean, and cultivated in the middle parts of Europe. It is usually met with in short quills or fragments of quills, of a greyish yellow colour, brittle, with a faint odour and an astringent taste.

It is said that the root bark of the common barberry, *Berberis vulgaris* L., and of the box-tree, *Buxus sempervirens* L. are substituted for that of the pomegranate. The fraud is easily detected, as neither of these substances, although very bitter, possesses the least astringency.—(*Neligan*.)

POTASSA, ACETATE OF.

Potassæ Acetas, U. S.

A very deliquescent salt difficultly obtained in the crystalline form, but usually occurring as a colourless white solid, with a foliated texture, given to it by fusion and cooling. It dissolves in its own weight of water at 60° F., and the solution has a pungent and sweetish saline taste. It is soluble also in twice its weight of boiling alcohol.

The most usual impurities of this salt are, the sulphate and tartrate of potassa, chloride of potassium and the salts

of lead and copper. The presence of tartrate of potassa will be shown by its insolubility in alcohol. A soluble sulphate may be detected by the white precipitate produced by chloride of barium; and chloride of potassium by the white precipitate caused by nitrate of silver. Lead and copper may be detected by sulphuretted hydrogen and ferrocyanide of potassium; the former test producing with the lead a blackish, and the latter with the copper a brown, precipitate. If the salt has an empyreumatic odour, it is owing to the presence of pyro-acetate of potassa.

In consequence of the deliquescent character of this salt it should be kept in well-closed bottles.

POTASSA, BICARBONATE OF.

Potassæ Bicarbonas, U. S.

This salt crystallizes in eight-sided prisms with dihedral summits. It is milder than the carbonate, but is alkaline both to the taste and to test paper. It does not deliquesce by exposure to the air, requires four times its weight of water at 60° for solution, and is much more soluble in water at 212° ; but it parts with some of its acid at that temperature, and at a low red heat is converted into the carbonate. The solution, when neutralized by nitric acid, should behave towards reagents exactly like a neutralized solution of the carbonate.

It may be distinguished from the carbonate of potassa by a solution of corrosive sublimate, which causes a slight white precipitate, and not one of a brick-red colour like the carbonate. This test only succeeds, however, when the bicarbonate is free from chloride of sodium.

POTASSA, BINOXALATE OF.

Salt of Sorrel.

This is a salt which crystallizes in white rhombs. It has a sour, pungent, bitterish taste, and reddens vegetable blues.

It is soluble in forty parts of cold, and six parts of hot, water. The solution gives a precipitate with a solution of chloride of barium, but the precipitate must dissolve completely in nitric acid, otherwise it contains sulphuric acid. It must give no precipitate with sulphuretted hydrogen gas, otherwise it contains lead, copper or some other metal. It gives a white precipitate with all solutions which contain lime; but as a test for this substance oxalate of ammonia is greatly to be preferred.—(See APPENDIX.)

POTASSA, BITARTRATE OF.

Potassæ Bitartras, U. S.—*Cream of Tartar*.

This salt occurs in commerce in the form of white crystalline crusts, or masses of aggregated crystals. It is soluble in ninety-five parts of water at 60°, and in fifteen of boiling water; insoluble in alcohol. From the boiling solution it is deposited in small crystalline grains, the primary form of which is either a right rectangular, or a right rhombic, prism. It has a sour taste, and reddens vegetable blue colours. It is not changed by exposure to the air, but when heated it decomposes, swells up, evolves various volatile products, and is converted into *black flux*, a compound of charcoal and carbonate of potassa sometimes used in the reduction of the metals.

Cream of Tartar, in its ordinary form, is often adulterated with various substances; as tartrate of lime, sulphate of potassa, copper, sand, pounded marble and silicious pebbles.

To detect these impurities, dissolve the cream of tartar, filter the solution, and neutralize it with a solution of potassa. The lime will then precipitate. Digest the cream of tartar in twenty parts of water, mixed with a little ammonia. The marble, sand, or ground pebbles will remain undissolved. Or add a dilute acid, when the effervescence, should any occur, will indicate the presence of marble. By mixing

the suspected cream of tartar with solution of ammonia, if a blue color is produced, the presence of copper may be inferred. Mix a portion of the cream of tartar with about three or four times its weight of distilled water, agitate the mixture frequently for about two hours, and then filter the solution. The sulphate of potassa being much more soluble than the bitartrate, the clear solution thus produced will contain the sulphate of potassa, and its presence may be known by its bitter taste, and by its giving a white precipitate, insoluble in muriatic acid, upon being tested with solution of chloride of barium. Cream of tartar is very susceptible of decomposition when in solution, or even when merely moist; it should, therefore, be kept in a perfectly dry state.

POTASSA, CARBONATE OF.

Crude Potash.

The *Potash* of commerce is in irregular lumps having various colours, as white, grey, blue, green and red. It consists principally of carbonate of potassa, but it is more or less mixed with sulphuret of potassium, chloride of potassium, sulphate of potassa, silica, alumina, oxides of iron and manganese, and various other substances. Sometimes common salt and other adulterants are added with fraudulent designs. The presence of most of these substances may be determined by the addition of the appropriate tests, after having carefully neutralized the alkali. But as the value of a sample of potash depends upon the proportion of carbonate of potassa which it contains, various modes have been devised for the purpose of determining this with accuracy. As this article is very deliquescent, it increases considerably in weight by exposure to the air. The amount of this increase may be easily ascertained by weighing a portion of the potash, and then in a porcelain capsule subjecting it to

the heat of a sand-bath for about half an hour. The loss of weight will give the quantity of water which has been expelled by the heat. To determine the quantity of real alkali in the sample under examination, an instrument called the *alkalimeter* may be employed. The following is a convenient mode of effecting this object: Into a tube sealed at one end, nine and a half inches long, three-fourths of an inch in diameter, and as cylindrical as possible in its whole length, pour 1,000 grains of water, and with a file or diamond mark the place where its surface reaches. Divide the space occupied by the water into 100 equal parts, placing the 0 at the upper part, and 100 at the bottom. Opposite to the numbers 48.96 and 65, draw a line, and at the first write potassa, and at the second carbonate of potassa. Then prepare a dilute acid having the specific gravity of 1.127 at 60° F., which may be made by mixing one measure of concentrated sulphuric acid with four measures of distilled water. This is the standard acid to be used in all the experiments, being of such strength that, when poured into the tube till it reaches either of the two marks just mentioned, we shall obtain the exact quantity which is necessary for neutralizing 100 grains of the alkali written opposite to it. If when the acid reaches the mark opposite to carbonate of potassa, and when, consequently, we have the exact quantity which will neutralize 100 grains of that carbonate, pure water be added until it reaches 0, or the beginning of the scale, each division of this mixture will neutralize one grain of carbonate of potassa. All that is now required, in order to ascertain the quantity of real carbonate in any specimen of potash or pearlash, is to dissolve 100 grains of the sample in warm water, filter to remove all the insoluble matters, and add the dilute acid in successive small quantities, until, by the test of litmus paper, the solution is exactly neutralized. Each division of the mixture indicates a grain of pure carbonate. It is convenient, in conducting this process, to set

aside a portion of the alkaline liquid, in order to neutralize the acid, in case it should at first be added too freely.

If we wish to use this instrument for the determination of the proportion of carbonate of soda in any sample of *Soda ash*, we have only to make marks upon the instrument opposite to 23.44 and 54.63, and to dissolve 100 grains in warm water, and treat it with the acid exactly as in the former case.

It is obvious that upon a similar principle we can ascertain the quantity of real acid in any given amount of diluted acid, and the instrument then becomes an *Acidimeter*.

This simple instrument may be advantageously employed in ordinary cases, but in accurate analytical investigations it cannot be relied on.—(See *Fresenius and Will's New Methods of Alkalimetry*, &c. ; and also *Ure's Dictionary of Arts*, &c. *Suppl.*)

The *Salt of Tartar* (*Carbonate of Potassa*) occurs in minute white crystals or grains. It has an alkaline and caustic taste, and is so very deliquescent as to form a dense solution when exposed to air. It is soluble in an equal weight of water at 60° ; insoluble in pure alcohol. The solution effervesces upon the addition of the stronger acids, gives a white precipitate with lime water and chloride of calcium, and is distinguished from that of the bicarbonate of potassa by a solution of corrosive sublimate causing a brick-red precipitate, except when chloride of sodium is present.

When the solution of this salt is neutralized by nitric acid, it should not produce a white precipitate, otherwise it contains silica. If the neutralized and clear solution gives a precipitate with a solution of nitrate of baryta, it contains sulphuric acid. If the same solution produces a precipitate with a solution of nitrate of silver, it indicates the presence of a chloride. And if, upon the addition of hydrosulphuret of ammonia, a precipitate results, we infer the presence of copper or iron. It is rarely the case that this salt is entirely

free from chlorides and sulphates, and from silica. If alumina is present, the neutralized solution will give a white precipitate with carbonate of ammonia.

POTASSA, CHLORATE OF.

Potassæ Chloras, L.

This salt crystallizes in white, four or six-sided scales, having a pearly lustre. Its taste is somewhat similar to nitre. It is soluble in sixteen or eighteen times its weight of water, at 60° , and in two and a half of boiling water. When exposed to a temperature of 400° or 500° , it undergoes igneous fusion; and on increasing the heat it gives out pure oxygen gas.

Chlorate of potassa is sometimes contaminated with chloride of potassium and sulphate of potassa. The former of these can be detected by the addition of nitrate of silver to a solution of the salt, and the latter by chloride of barium. A white insoluble precipitate will be caused by the nitrate of silver, if chlorine is present, and by the chloride of barium, if sulphate of potassa is mixed with the salt. The purity of the chlorate for ordinary purposes, may be determined by mixing intimately in a mortar two parts of the salt and one part of pounded loaf sugar, and touching the mixture with a drop of oil of vitriol. If the mixture inflames instantly, the salt is sufficiently pure for ordinary uses.

For two or three years past I have observed that the oxygen gas which I have procured from chlorate of potassa is more or less mixed with chlorine. The specimens used were all of French manufacture, or at least had French labels. The evolution of chlorine is probably due to a small admixture of hypochlorite of potassa, from a want of care in the process.

POTASSA, CHROMATE OF.

This salt occurs in the form of beautiful yellow crystals, the primary form of which is a right rhombic prism. It has a cool, bitter and disagreeable taste; is soluble to a great extent in boiling water, and in twice its weight of the liquid at 60°; insoluble in alcohol.

A very common adulterant of this salt is the sulphate of potassa, with which the chromate is isomorphous and perhaps forms a double salt. Crystals of this kind are sometimes sold for pure chromate of potassa, which contain more than fifty per cent. of sulphate of potassa. The fraud can be easily practised by the substitution of sulphuric, instead of nitric, acid, in the manufacture. It may be detected by dissolving the suspected chromate in water, and adding to the liquid a solution of nitrate of baryta as long as it produces a precipitate. Pour off the supernatant solution, wash the precipitate in water, and then pour nitric acid over it. The chromate of baryta will be dissolved, but the sulphate of baryta, if any is present, will remain undissolved. The proportion of sulphate of potassa in any specimen of chromate of potassa may thus be easily ascertained.

Bichromate of Potassa is liable to the same adulteration as the chromate. Its presence and amount may be determined by the process just described.

POTASSA, NITRATE OF.

Potassæ Nitras, U. S.—*Nitre*—*Saltpetre*.

A colourless salt, crystallizing in six-sided prisms, having a saline taste, accompanied with an impression of coolness. It is soluble in four or five parts of water, at 60° F., and in less than its own weight of boiling water. When thrown upon burning coals it deflagrates, by which it may be distin-

guished from sulphate of soda for which it is often mistaken. At the temperature of 616° F., it undergoes the igneous fusion, and gives a transparent, colourless liquid, which concretes on cooling into a white mass.

Nitrate of potassa, in its commercial form, is more or less adulterated with chloride of potassium, chloride of sodium, sulphate of potassa, sulphate of soda, nitrate of soda and earthy matters of various kinds. It may also contain an undue proportion of moisture. In consequence of the extensive employment of this salt, and of its being in some cases required in a state of purity, the processes for the detection of these impurities become of considerable importance.

Detection of Earthy Matters, Chlorides and Sulphates.—Dissolve a portion of the suspected salt in hot water. The proportion of insoluble earthy matters may be ascertained by filtration. To the clear solution add a few drops of chloride of barium; a white precipitate, insoluble in nitric acid, will be produced if the nitre is mixed with a soluble sulphate. To another portion of the solution add solution of nitrate of silver; a white insoluble precipitate will show the presence of a soluble chloride. In both these cases the proportions of the impurities may, in some measure, be judged of by the rapidity with which the precipitates subside, and by their amount. The presence of lime can be detected by the white precipitate produced by solution of oxalate of ammonia. But it is more difficult to determine whether the sulphuric acid and chlorine are combined with soda or potassa, sodium or potassium.

Detection of Water.—The presence and proportion of moisture in a sample of saltpetre may easily be determined by subjecting a known weight of it to the heat of a sand bath, and noting the loss.

Detection of Nitrate of Soda.—This salt, from its being

somewhat deliquescent, is very injurious to nitre intended for the manufacture of gunpowder. It may be separated by washing the mixed salt with ice cold water, in which the nitrate of soda is very soluble, while the nitrate of potassa is very sparingly so. On slowly evaporating the solution thus obtained, crystals of a rhombohedral form will be produced, if nitrate of soda is present. When the nitre, however, contains both common salt and nitrate of soda, the presence of the latter can only be determined by employing some of the processes for the detection of nitric acid.

Detection of Metals.—If the dark colour of saltpetre is owing to the presence of a metal, it may be ascertained, if in the form of a soluble compound, by passing a stream of sulphuretted hydrogen through a solution of the suspected salt.

A rough method of determining the value of a sample of nitre, and which, in some cases, especially where common salt is the chief impurity, admits of considerable accuracy, consists in putting a pound of the salt in powder into a basin, and pouring upon it a pint of a saturated aqueous solution of pure nitre; this mixture is well stirred for fifteen or twenty minutes, then left at rest, and when the salt is deposited, the liquor is poured off and filtered. Half a pint of the saturated solution of pure nitre is again poured upon the remaining salt, stirred as before, and then the whole contents of the basin carefully transferred to the filter. In some cases, where the quantity of common salt is excessive (exceeding 66 per cent.), the washing must be repeated a third time; but this is rarely necessary. When the dripping of the filter has ceased, it is carefully removed with its contents from the funnel, and placed upon a few sheets of coarse filtering paper lying upon a chalk table or other absorptive substance, the saltpetre being carefully spread out so that the moisture may be absorbed. When

it is dry enough to admit of removal, it must be carefully transferred into a basin placed upon a sand bath, and the drying completed, till it no longer adheres to the rod or ivory knife with which it is stirred. It is then weighed, and the loss of weight (as compared with the sample) gives the impurities; but from this about two per cent. must be deducted for the nitre deposited by the saturated solution whilst taking up the common salt.—(*Brande's Chemistry.*)

POTASSA, SULPHATE OF.

Potassæ Sulphas, U. S.

A white, slightly bitter salt, which crystallizes in short six-sided prisms, terminated by six-sided pyramids. It is destitute of water of crystallization, suffers no change by exposure to the air, and is soluble in sixteen parts of cold, and five of boiling, water.

Sulphate of potassa sometimes contains a notable proportion of sulphate of zinc, copper or iron, arising from the fact that the salt procured from Germany is a secondary product of the manufacture of nitric acid, in which sulphate of iron has been substituted for sulphuric acid. To detect these substances, make a solution of the suspected salt in water, and then add a small portion of solution of ammonia. If it contains zinc, a white precipitate will be produced, which is soluble in an excess of the alkali. The presence of copper will cause a blue solution; and of iron, brownish red flocks of the sesquioxide of that metal.

POTASSA, TARTRATE OF.

Potassæ Tartras, U. S.—*Soluble Tartar.*

This salt occurs in anhydrous crystals, the primary form of which is a right rhombic prism. It has a saline and bitter taste, and is soluble in less than twice its weight of water. When heated to redness it is decomposed, leaving

a residue of charcoal and carbonate of potassa. It is distinguished from the bitartrate by its being deliquescent, its greater solubility, and its want of acidity.

Sulphate of soda, sulphate of potassa, chloride of potassium, and cream of tartar, are the usual impurities of this salt. The presence of the sulphates may be detected by testing the solution with the solution of acetate of baryta. If the resulting precipitate is insoluble in nitric acid, the soluble tartar contains sulphates. If nitrate of silver causes a white precipitate, insoluble in nitric acid, the soluble tartar contains a chloride. Cream of tartar may be detected by its remaining undissolved when twice the weight of water is added to the suspected salt. The presence of iron may be proved by the blue precipitate produced upon the addition of ferrocyanide of potassium to the solution of the soluble tartar; and of copper, by the blue colour which is the result of its mixture of ammonia.

POTASSA AND SODA, TARTRATE OF.

Sodæ et Potassæ Tartras, U. S.—*Rochelle Salt*,

Occurs in large prismatic crystals of which the primary is a right rhombic prism. It has a glassy fracture, a mildly saline taste; it is permanent in the air and soluble in two parts of cold water. It may contain sulphates of soda and potassa, and chlorides of sodium and potassium:—Dissolve the salt in water, when the insoluble impurities will remain at the bottom of the vessel and may be separated by filtration. To the filtered solution add chloride of barium. If a white precipitate results which is insoluble in nitric acid, the salt contains sulphuric acid. If nitrate of silver, when added to the solution, gives a precipitate insoluble in nitric acid, we infer the presence of a chloride. The solution ought to be transparent and to give a crystalline deposit of cream of tartar upon the addition of sulphuric acid.

POTASSIUM, BROMIDE OF.

Potassii Bromidum, L.

It crystallizes in white cubes or rectangular prisms which are destitute of water, decrepitate when heated, and enter into fusion without suffering any change. It is permanent in the air, very soluble in water, and slightly so in alcohol.

A solution of this salt should give no precipitate with chloride of barium, showing the absence of carbonates and sulphates. It should not change the colour of litmus or turmeric, and with starch and sulphuric acid it should give a yellow colour. The presence of a chloride may be determined by mixing the suspected salt with excess of bichromate of potassa, distilling it with strong sulphuric acid in a tubulated retort, to which is adapted a receiver containing excess of caustic ammonia. If the bromide be pure, bromine distils over and the ammoniacal liquor remains perfectly colourless. But if the bromide contain a chloride, both bromine and the chromate of chloride of chromium distil over, and the ammoniacal liquor becomes yellow; chromic acid may be detected in the liquid by the tests for that substance. If this salt contains iodine, the addition of sulphuric acid and starch will cause the solution to assume a violet or blue colour.

Bromide of potassium should always be purchased in crystals.

POTASSIUM, CHLORIDE OF.

Muriate of Potassa.

This substance occurs in cubic crystals, which have a saline and bitter taste, require three parts of water at 60° for solution, and rather a less proportion of boiling water. It is much used in the manufacture of alum. The solution should

be perfectly neutral. If it gives a precipitate with a solution of chloride of barium, it probably contains sulphate of potassa. If it turns black when tested with sulphuretted hydrogen, it contains some metal.

Chloride of potassium is also often adulterated with common salt, the proportion of which it may be important to determine. The following process is recommended for this purpose by Mr. H. Watson: "Treat the sample with sulphate of ammonia till all the chloride is converted into sulphate; evaporate the resulting mixture to dryness, and calcine till all the ammoniacal salt is dissipated. The residue consists of the anhydrous sulphate of the alkali or alkalies of the sample. By placing this under an exhausted receiver along with a vessel of pure water, we shall be able to ascertain whether it is pure sulphate of potassa, or is mixed with sulphate of soda. If it be the former it will not increase in weight, however long the experiment may be continued; but if there is any sulphate of soda present, it will gain weight till that portion becomes of the same constitution as it is when it exists in the crystalline state.—(*Lond. Phil. Mag.* xii., 132.)

Another mode of arriving at this result is founded upon the different degrees of cold produced by mixture of common salt and chloride of potassium. The chloride of potassium, when pulverized and dissolved in four times its weight of cold water, produces a depression of temperature of 20 to 25 degrees; while chloride of sodium lowers the temperature only two or three degrees. This, however, cannot be considered as a very accurate test.

POTASSIUM, CYANIDE OF.

Potassii Cyanuretum, U. S.—*Cyanuret of Potassium*.

A white substance, sometimes in the form of a crystalline mass, having an enamelled appearance. It is inodorous

when quite dry, but if moistened gives out the odour of hydrocyanic acid. It has a pungent, alkaline and somewhat bitter taste, and is very poisonous. It is deliquescent in moist air, very soluble in water, and sparingly so in alcohol.

If this salt is at all yellow, it probably contains iron, which diminishes its activity. If it gives out the smell of hydrocyanic acid, it contains water and is of uncertain strength. Sometimes, also, it is adulterated with carbonate and formate of potassa; the former of which may be detected by its effervescence in dilute acids, and the latter, by its becoming black when calcined. A spurious cyanide, formed by calcining dried muscular flesh with potassa, consists principally of carbonate of potassa, and is said to be but slightly poisonous.

The purity of the cyanide of potassium may be ascertained by the property which its solution possesses of dissolving the red oxide of mercury. Twelve grains of the pure cyanide dissolve twenty grains of finely powdered oxide of mercury. Cyanide of mercury is formed, and potassa set free.—(*Graham's Chemistry.*)

POTASSIUM, FERROCYANIDE OF.

Potassii Ferrocyanuretum, U. S.—*Prussiate of Potash*.

This salt occurs in the form of large four-sided crystals of a lemon yellow colour, and having a specific gravity of 1.83. It has a saline and bitter taste, is not poisonous; soluble in four times its weight of cold, and in about its own weight of boiling, water. When moderately heated it loses water and is converted into a white friable powder. At a red heat the cyanide of iron of the salt is decomposed, and the residue consists of cyanide of potassium, oxide of iron and carbon. It gives a blue precipitate with the sesquioxide of iron, and when heated with dilute sulphuric acid, evolves hydrocyanic acid.

The above properties will serve to characterize this substance. When in the crystalline form it is seldom adulterated. Subjected to a red heat, the residue dissolved in muriatic acid, and precipitated by ammonia, should give 18.7 parts of sesquioxide of iron for every 100 of the salt.

POTASSIUM, IODIDE OF.

Potassii Iodidum, U. S.—*Hydriodate of Potassa*,

Occurs in the form of white cubical crystals, similar to those of common salt. It fuses readily when heated, and is volatilized at a temperature below redness. It deliquesces in a moist atmosphere, and is very soluble in water; soluble also in strong alcohol. The solution may be known by its producing a rich yellow precipitate, with solution of acetate of lead, and a vermilion red precipitate, with a solution of corrosive sublimate, while an excess of strong solution of tartaric acid produces a white crystalline precipitate. On the addition of a cold solution of starch, and a few drops of sulphuric acid, to the solution of the iodide of potassium, the characteristic blue compound of iodine and starch is formed.

Iodide of potassium is often largely adulterated with carbonate of potassa, and contains traces of alkaline chlorides and sulphates, and occasionally also of metallic matter. Carbonate of potassa may be detected by the production of carbonate of lime, upon the addition of lime water to a solution of the suspected iodide, and by its destroying the colour of tincture of iodine; whereas the pure salt does not affect it. Iodide of potassium is moreover soluble in alcohol, while carbonate of potassa is not. Dr. Pereira has found seventy-seven per cent. of this impurity in a sample of the iodide. An adulteration by the carbonate of potassa of not more than ten per cent. does not alter the crystalline appearance of the iodide, but somewhat increases its deliques-

cence. When it is in larger proportion it renders the salt granular and highly deliquescent. The amount of water, when present as an impurity, may be determined by carefully drying the salt, and ascertaining the loss of weight.

Detection of Chlorides.—To detect any chloride, the following method may be followed: Precipitate the solution of the iodide completely by nitrate of silver, add excess of ammonia, and filter. If any chloride of silver was formed, this is now in the filtered liquid, held in solution by ammonia, and may be precipitated by nitric acid; but as iodide of silver is not perfectly insoluble in ammonia, a faint turbidity on adding nitric acid to the filtered ammoniacal solution, may always be expected.

Detection of Sulphates.—If any sulphates are contained in the iodide of potassium, they may be known by the white precipitate, insoluble in nitric acid, caused by the addition of chloride of barium. The presence of metallic matter can, in general, be shown, by adding a small quantity of acid to the solution of the suspected iodide, and treating the liquid with sulphuretted hydrogen, when, if it contains lead or tin, (derived from the vessels in which the salt has been crystallized,) the characteristic precipitates will be produced.

Detection of Iodate of Potassa.—Mr. Scalan has shown that iodide of potassium is occasionally contaminated with iodate of potassa. This variety undergoes decomposition by keeping, becomes of a pinkish colour, and emits an odour of iodine. A solution of tartaric acid, if the iodate of potassa is present, causes the evolution of a quantity of free iodine; but no such effect is produced by this reagent in a solution of pure iodide of potassium. Whether iodate be present or absent, however, the addition of tartaric acid causes the precipitation of crystals of bitartrate of potassa.

Iodide of potassium should always be purchased in crystals, which ought not to be very deliquescent, and should perfectly dissolve in six or eight parts of alcohol of the specific gravity of 0.836.

POTASSIUM, PROTOXIDE OF.

Potassa, U. S.—Caustic Potassa.

A white solid, very caustic, changing vegetable blues to green, and neutralizing the strongest acids. It is fusible at a red heat, and volatile when heated to whiteness; very deliquescent, and hence very soluble in water. With tartaric acid the solution of potassa gives a white crystalline precipitate, the bitartrate of potassa, appearing sooner or later according to the concentration of the liquid.

Potassa is often contaminated with carbonate of potassa, sulphate of potassa, chloride of potassium, lime, silica and alumina. The pure solution of potassa ought to be colourless. If it contains carbonate of potassa it effervesces when treated with an acid. After being neutralized with nitric acid, it ought not to give a precipitate with nitrate of silver, else it contains chlorine, nor with chloride of barium, otherwise it contains sulphuric acid. If it contains lime, carbonate of potassa will immediately cause a white precipitate. If it is rendered turbid on being heated with an equal measure of solution of muriate of ammonia, it contains alumina; and if on evaporation a portion of the residue is insoluble in water, it contains silica.

If potassa is required absolutely pure, it must be made from carbonate of potassa prepared from the bicarbonate or bitartrate of potassa.

Potassa Fusa (*fused potassa*) must dissolve in water without leaving brown flocks, otherwise it contains peroxide of iron. The solution must be colourless, and must not be

affected by the reagents above mentioned. This, as well as the preceding, should be kept in well-stopped bottles.

Solution of Potassa, as kept in the shops, is frequently too weak. It should have a density of from 1.063 to 1.080.

PRUSSIAN BLUE.

Ferri Ferrocyanuretum, U. S.

This substance has a rich and intense blue colour, with a copper tint upon its surface. It is insipid, inodorous, not poisonous, insoluble in water and alcohol, and decomposed by the alkalies. It varies greatly in the intensity and beauty of its colour.

The Prussian blue of commerce generally contains alumina and sesquioxide of iron. These may be detected by boiling the suspected compound with dilute muriatic acid, in which they are both soluble. They may be precipitated from the solution by caustic potassa; excess of the alkali dissolves the alumina, and leaves the sesquioxide of iron. If the sample effervesces with acids it is adulterated with chalk, and if it becomes pasty with boiling water it is mixed with starch. The Paris blue, prepared without alum, with a persalt of iron displays, when rubbed, a copper red lustre, like indigo. When Prussian blue is degraded in its colour by an admixture of free oxide of iron, it may be improved by digestion in dilute sulphuric or muriatic acid, washing and drying. The relative value of various specimens may be estimated by the quantity of potassa or soda required to destroy the colour of a given quantity of the Prussian blue. —(*Ure's Dictionary*.) An experienced dealer may, by simple inspection, form a tolerably correct judgment of its value. The only trial to which it is customary to subject this article, is that of braying it with white lead in oil, and ascertaining the proportion of the blue which is required to raise a given quantity of the white lead to a determinate shade.

The pigment known by the name of *Turnbull's blue*, has a lighter and more delicate tint than Prussian blue, with which, however, it may be confounded. It is distinguished by the circumstance that when boiled in a solution of ferrocyanide of potassium, (yellow prussiate of potassa,) it affords red ferricyanide of potassium, which dissolves, and leaves a grey insoluble residue of ferrocyanide of iron and ferrocyanide of potassium.—(*Liebig.*) It is used by calico-printers, and is probably liable to nearly the same adulterations as Prussian blue.

PURPLE OF CASSIUS.

This is a powder of a purple colour, formed by the addition of the protochloride of tin to a dilute solution of chloride of gold as long as it causes any precipitation. The precipitate is then filtered and dried. It is used in enamel and porcelain painting, and for tinging glass of a fine red colour. It is soluble in ammonia, and does not form an amalgam with mercury. When heated to redness it loses water, and the residue is a mixture of metallic gold and peroxide of tin. The gold may be separated by solution in aqua regia, while the peroxide of tin remains behind, if, previous to the filtration of the peroxide, care be taken to destroy as completely as possible the free muriatic acid in the solution by the addition of nitric acid. The gold may afterwards be precipitated from its solution by a solution of the protosulphate of iron.

There are various methods of preparing this valuable article, and its composition varies considerably. The substitution of other substances for it may be detected by an attention to the above characters.

QUASSIA.

Quassia, U. S.

The article which ordinarily occurs under the above name is the wood of the *Quassia excelsa* Swartz, (*Picræna excelsa* Lindley,) a native of Jamaica. The wood is white, but by exposure to the air becomes yellowish; it is without odour, but has an intensely bitter taste. It yields its bitterness to boiling water and to alcohol.

The chips of quassia wood are sometimes mixed with those of other wood, but the intense bitterness of the former will readily distinguish it.

QUININE OR QUINIA.

This is one of the vegeto-alkalies usually obtained from the yellow bark, *Cinchona cordifolia* Mut. When pure, it occurs in white needle-form crystals, which are intensely bitter, soluble in 200 parts of boiling water, almost insoluble in cold water, and highly soluble in alcohol and ether. It forms salts with acids, which are generally crystallizable. It is not used in its uncombined form. It is liable to be mixed with cinchonine, for which the tests will be found in the next article.

QUININE, DISULPHATE OF.

Quiniæ Sulphas, U. S.—*Sulphate or Subsulphate of Quinine.*

This salt, which is now largely manufactured, crystallizes in delicate white needles, which are very light and have the appearance of amianthus. It is efflorescent, intensely bitter, requires about 740 parts of cold, and 30 parts of boiling, water for solution. It is soluble in 60 parts of cold alcohol, but in much less of hot. Very soluble in dilute sulphuric

acid. It possesses the remarkable property of becoming luminous when heated a little above the boiling point of water, especially when rubbed.

In consequence of the value of this salt it is often adulterated with various substances, as sugar, gum, starch, stearine, ammoniacal salts, sulphates of lime and magnesia, salicine and cinchonine.

Detection of Sugar, Gum and Starch.—Sugar may be detected by dissolving the suspected salt in water, and adding precisely so much carbonate of potassa as will precipitate the quinine. The sugar may be separated by evaporating the filtered solution to dryness, and dissolving the residue by boiling alcohol. Gum and starch are left when the impure disulphate of quinine is digested in strong alcohol.

Detection of Ammoniacal and Earthy salts.—If ammoniacal salts are mixed with the disulphate of quinine, the fraud may be detected by the odour of ammonia which is given out when the mixture is put into a strong solution of potassa. And if the suspected disulphate is subjected to a red heat in a platinum spoon, the residue, if any, consists of earthy matters, the precise nature of which may, if necessary, be determined by subsequent trials.

Detection of Stearine.—The presence of stearine may be ascertained by treating the suspected disulphate of quinine with water acidulated with muriatic acid. The disulphate is dissolved, but not the stearine. If the mixture is heated, the stearine swims on the surface of the liquor, and forms little transparent drops, which become opaque when the liquor cools.

Detection of Salicine.—Recently, disulphate of quinine has been largely adulterated with salicine. The presence

of this substance, when in considerable proportion, can be easily detected by the addition of sulphuric acid, which produces a fine red colour, while with the disulphate this acid forms a colourless solution. Where only a small proportion of salicine is mixed with the disulphate the following process may be employed: Pour on two parts of the disulphate twelve parts of concentrated sulphuric acid. The salt will be dissolved and coloured brown. Add 250 parts of distilled water; the brown colour disappears, and the salicine remains white and suspended in the liquid. The salicine is not dissolved by this acid solution of sulphate of quinine. Filter and collect on a glass, and the white bitter powder will give, with cold concentrated sulphuric acid, the vivid red reaction. The water should be added in small quantities at a time, and we should cease to add it when a precipitate is obtained which separates with facility.

Detection of Cinchonine.—The samples of disulphate of quinine are now rarely free from the corresponding salt of cinchonine. Various processes have been suggested for the detection of this mixture. One of these depends upon the different action of chlorine upon the salts of quinine and cinchonine. If the disulphate of quinine be dissolved in a large quantity of chlorine water, and some water of ammonia is added, a deep green precipitate is formed, and the liquor also becomes intensely green. A salt of cinchonine similarly treated forms a dark red solution. Another mode consists in dissolving a portion of the mixed salt in water, and precipitating the solution with ammonia, collecting the precipitate, and boiling it in alcohol. If any cinchonine is present, it will be deposited in crystals as the liquor cools, while the sulphate of quinine remains in the mother liquor. According to M. Calvert, a saturated solution of disulphate of quinine in cold water gives, with a solution of chloride of lime, a precipitate, soluble in an excess of the latter; while a so-

lution of sulphate of cinchonine of the same strength, treated in the same manner, gives a precipitate which is insoluble in a great excess of the reagent. The same effect is produced with lime water and solution of ammonia ; and solution of chloride of calcium, while it furnishes a precipitate with a solution of sulphate of cinchonine, yields none with a solution of disulphate of quinine. For other distinctive characters of quinine and cinchonine, and their salts, see *Pereira's Materia Medica*.

It should be added that the disulphate of quinine sometimes contains water in such an undue proportion as to constitute an adulteration. This is the case if one hundred parts of the salt lose more than eight or ten parts of their weight by the application of a gentle heat. Finally, to complete the catalogue of frauds, the bottles which come to us from France, purporting to contain an ounce of the disulphate, very rarely yield that amount ; the reduction of weight being either the result of an understanding between the manufacturers and the wholesale dealers, or of the direct removal of a portion of the salt after it has been brought into this country.

RED SAUNDERS.

Santalum, U. S.—*Sandal Wood*.

The wood of the *Pterocarpus santalinus* L., a native of India. It comes in roundish or angular billets, having a blood red colour internally, of a fibrous texture, compact and heavy. It has little or no taste or smell, and yields its red colour to alcohol and alkaline solutions, but not to water, by which it may be distinguished from other colouring woods. The alcoholic tincture gives a deep violet precipitate with the sulphate of iron, a scarlet one with the bichloride of mercury, and a violet with the soluble salts of lead. The colouring matter called *Santalin* is very soluble

in alcohol, ether, acetic acid, alkaline solutions, but scarcely so in cold water.

The above characters will serve to distinguish this wood from other woods which may be substituted for it.

RHUBARB.

Rheum, U. S.

The root or root-stalks of various species of *Rheum*, as *R. palmatum* L., a native of Mongolia on the borders of China, *R. undulatum* L., which inhabits Siberia and China, *R. compactum* L., growing in Thibet and Mongolia, and *R. Rhaponticum* L., found on the banks of the Euxine and Caspian seas. The principal varieties known in commerce, are the Russian or Turkey, the Chinese or East Indian, and the European.

Russian Rhubarb.—This is called *Turkey Rhubarb*, from its having been formerly brought to Europe through the Turkish ports. It is now principally obtained from St. Petersburg. It occurs in roundish pieces, sometimes flattened on one side ; of a bright yellow colour externally ; internally marbled with yellow, red, and white streaks or points. It is without any epidermis, and is generally perforated with a large hole. It has an aromatic, strong and peculiar odour, a bitter and faintly astringent taste, and tinges the saliva of a yellow colour. It feels gritty between the teeth, owing to the presence of crystals of oxalate of lime. It is easily pulverized, and the powder is of a bright yellow colour.

Chinese or East Indian Rhubarb, occurs in globular or flat pieces, rounded, not angular on the surface, of a brownish yellow colour, and usually presenting some trace of epidermis. It is perforated with cylindrical holes, which sometimes contain pieces of cord by which the roots were suspended while drying. It is compact, and internally mar-

bled and spotted yellowish brown and whitish. Its odour is somewhat stronger than that of the Russian rhubarb, its taste is similar, but its powder is of a less bright colour.

European Rhubarb.—The rhubarb has been for many years largely cultivated in various parts of Europe, and a considerable proportion of the root in market is from this source. The English rhubarb sometimes occurs in pieces about five or six inches long, and half an inch in diameter, round, striated, externally of a dirty yellowish brown colour, internally, blackish, with reddish streaks. It has a faint odour, an astringent taste, and is not gritty. This variety is known by the name of *Stick Rhubarb*. Another kind of English rhubarb, known in the shops by the name of *Trimmed Rhubarb*, is prepared to represent Turkey rhubarb, for which it is often sold. Its texture, however, is soft and spongy; it has a pinkish hue, is mucilaginous, and is pulverized with difficulty. It has an astringent taste, a faint odour, and is not gritty between the teeth. The French rhubarb is chiefly the produce of the *R. Rhaponticum*, *R. undulatum*, and *R. compactum*. Two kinds are described, both under the name of *Rhapontic root*. One proceeds from the former of these species, growing in the gardens around Paris; the other is from a place called Rheumpole, not far from L'Orient, and is the produce of all the three species just mentioned. The former is in pieces of the size of the fist or less, which are ligneous in their appearance, of a reddish grey colour on the outside, internally marbled with red and white in the form of rays. It has an odour like that of the Asiatic rhubarb, but more disagreeable; an astringent and mucilaginous taste, not crackling under the teeth, but tinging the saliva of a yellow colour. The latter variety is in irregularly cylindrical pieces of three or four inches in length, less ligneous in appearance than the former, and externally of a brownish yellow col-

our. It resembles the Chinese rhubarb, but may be distinguished by its more disagreeable odour, its astringent and mucilaginous taste, its want of crackling under the teeth, and its radiating fracture. Considerable quantities of this drug are said to have been imported into the United States from France, under the name of *Krimea Rhubarb*; and it is probably sometimes employed to adulterate the powder of the Chinese rhubarb.—(*U. S. Dispensatory.*)

The most common adulterations of rhubarb are the substitution of inferior sorts for the finer kinds. This is especially practised when the drug is sold in powder. It then becomes exceedingly difficult to detect the fraud, as even the bright yellow colour, which characterizes the finer kinds, may be imitated by the addition of some colouring matters. When rhubarb is purchased in mass, which it should always be, if practicable, particular attention should be given to the characters of the different kinds. As a general rule, those pieces should be preferred which are moderately heavy and compact, have a bright colour, a fresh appearance when broken, with reddish, yellowish and whitish veins intermixed, an aromatic odour, an astringent not mucilaginous taste, give the saliva a yellow colour when chewed, and yield a powder of a bright yellow colour, or a yellow slightly tinged with reddish brown. When the pieces of rhubarb are worm eaten they are of inferior value. This deterioration is sometimes attempted to be concealed by filling the holes with a paste of rhubarb powder and mucilage; after which the mended pieces are rolled in the finest rhubarb powder to give them an appearance of freshness. Rhubarb ought not, therefore, to be purchased without breaking and examining each lump. The inferior kinds are sometimes employed in the preparation of the tincture of rhubarb.

ROSES, OTTO OR ATTAR OF.

Oleum Rosæ, U. S.

This precious article is obtained in the East, by the distillation of the petals of the *Rosa damascena* L., *R. moschata* Mill., and other species. It is colourless, or has a tint of green, yellow or red ; but it is said that the colour is no criterion of its value. It has the odour of roses, but unless diffused through the air, or some liquid, is too powerful to be agreeable. At temperatures below 80° F., it is a crystalline solid. Its specific gravity at 92°, compared to that of water at 60°, is 0.832. It is sparingly soluble in alcohol.

Sandal-wood oil, and other volatile and fixed oils are said to be sometimes employed as adulterants of the otto of roses. The volatile oils may be detected by not being concrete ; the fixed ones by the greasy stain which they leave upon paper, when subjected to heat.

ROUGE.—See SAFFLOWER.

SAFFLOWER.

Carthamus, U. S.—*Dyers' Saffron*.

The florets of the *Carthamus tinctorius* L., a native of the Levant and Egypt, but cultivated in various parts of Europe and America. When in mass, safflower is of a red colour, diversified by the yellowness of the filaments contained within the florets. It has a peculiar, slightly aromatic odour, and a scarcely perceptible bitterness. It contains two colouring matters—one yellow, and the other red. The first alone is soluble in water, and as this is not employed, it is removed by washing the safflower, in a linen bag, in a stream of pure cold water. The residue yields the red colour, by digestion

in a cold solution of carbonate of soda, from which it may be precipitated by a weak acid, lemon juice being preferred.

The article called *rouge*, which is employed as a cosmetic, is prepared from the red colouring matter of the safflower, carefully ground with talc in fine powder. It is the fineness of the talc, and the greater or less proportion which it bears to the safflower precipitate, which constitutes the difference between the high and low priced kinds of rouge. When this article is adulterated, as it sometimes is, with mineral colouring matters, it is very injurious to the skin. These may be detected by the residue which is left when the suspected rouge is subjected to calcination. Light greatly injures the red colour of safflower, and age is nearly as injurious to it, especially when in a damp state.

Safflower is sometimes fraudulently mixed with saffron; from which it may be distinguished by the tubular form of the florets, and by their yellowish style and filaments.— (See the next article.)

SAFFRON.

Crocus, U. S.

The article known by this name, consists, when pure, of the stigmas of the *Crocus sativus* L., a native of Asia Minor, largely cultivated in England, and elsewhere. The English saffron, formerly in such great repute, has, it is said, almost disappeared from market; the principal supply of the drug is now obtained from Spain and France. It has an aromatic odour, a pungent, bitter aromatic taste, and a deep red colour. It yields its virtues to alcohol, wine, vinegar and water.

As good saffron should consist of the stigmas alone, it bears a high price in market. Its value is further enhanced by the diseases to which the *Croci* are liable; and fraudulent dealers are therefore tempted not only to mix the stamina

of the plant with the pistils, but also to adulterate the drug with the petals of the safflower, *Carthamus tinctorius* L., the marigold, *Calendula officinalis* L., and even the dried fibres of beef. These admixtures can easily be detected either by maceration, which will develop the form of the petals, or by burning a small quantity of the suspected sample, when, if dried flesh is present, it will be betrayed by the peculiar animal odour. *Carthamus* is composed of a fine red coloured tube, divided into five sections at its upper part, and still containing the organs of fructification. Its odour is far from being so agreeable or so powerful as that of saffron. In water it produces also a brownish yellow solution, while true saffron yields a golden yellow liquid. This fraud may also be detected by infusing the suspected saffron in hot water, when the flowers of the safflower may be readily distinguished from the stigmas of the saffron. The same mode of procedure will detect the flowers of the calendula. Sometimes saffron has been either wholly or partially deprived of its colour by previous infusion, a fraud which can be detected by the paler colour and fainter odour of such saffron, and by its communicating to the saliva a feeble yellow colour. Saffron should not be kept in a moist place, in consequence of its suffering a slight fermentation, by which many of its good properties are destroyed. It suffers deterioration by exposure to the air, which should, therefore, be as carefully excluded from it as possible.

SAGO.

Sago, U. S.

This is a farinaceous substance, obtained from the inner and pith-like portion of the stems of many palms, but is particularly abundant in the *Metroxylon sagus* Kön., (*Sagus Rumphii* Willd.,) which grows to the height of thirty feet in the Moluccas and Philippines. It occurs in the form of a white

powder, (*Sago meal*) or in pearly grains (*Pearl sago*); both kinds having a yellow white colour, a faint musty odour, but no taste. The pearl sago, which is the kind now generally used, is in hard grains, of the size of a pin's head to that of a pea, in some instances translucent, inodorous, and with little taste. It is insoluble in water, but when boiled in that liquid, the grains swell up, become transparent, and form a mass of mucilaginous globules. In its chemical properties sago resembles the other starchy bodies. According to Dr. Ure, when examined by the microscope, a particle of sago appears like a spherule of snow surrounded by brilliants. The grains also have a brilliant surface, acquired by heating and stirring the fine particles of the sago palm, in a damp state, upon iron, or other plates.

Potatoe sago is sometimes sold for white, or bleached, pearl sago. The fraud can be detected by the microscope. The largest particles of potatoe sago are larger than those of palm sago, and the particles of potatoe sago are also more regularly oval and ovate, more distinctly ringed, smoother, and less broken than those of genuine sago. When their circular hilum cracks, it frequently forms two slightly diverging rents.—(*Pereira.*)

SALEP.

This is the name applied to the tubers of various species of *Orchis* imported from Persia and Asia Minor, but which are principally the produce of the *Orchis mascula* L. It occurs in commerce in small oval grains, of a yellowish white colour, at times semi-transparent, very hard, having a peculiar smell and a taste like that of gum tragacanth, but slightly saline. It is composed of starchy and gummy matter, and forms a thick pap with water or milk. It should not be bought in powder, because in that state it is very apt to be adulterated. A factitious article is manufactured by baking potatoes which have been peeled and

cut into slices, until they are brittle, and then grinding them into powder.

SALICIN.

A peculiar substance obtained from the bark of the white willow, *Salix alba* L., and from several other species of this genus. It crystallizes in white, silky needles or laminae. It is inodorous, but has an intensely bitter taste, is neutral to vegetable colours, soluble in eighteen or twenty parts of cold, and in one of boiling, water. It is also soluble in alcohol, but not in ether or oil of turpentine. It is permanent in the air, fuses at 230° F., and is decomposed at a higher temperature.

Salicin is not precipitated by any reagent. When sulphuric acid is added to it, the solution which is thus effected assumes a deep red colour. By this test salicin may be distinguished from disulphate of quinine, for which it is sometimes substituted. When mixed with that salt as an adulterant, its presence may be detected by the process given in the article QUININE, DISULPHATE OF.

SANTALUM.—See RED SAUNDERS.

SARSAPARILLA.

Sarsaparilla, U. S.

This is the root of various species of *Smilax*, as, *S. officinalis* Kunth, *S. medica* Schlecht., *S. syphilitica* Humb., and *S. Sarsaparilla* L., all natives of the warmer parts of South America. Several varieties of this drug are known in commerce; the most important of which are, Jamaica, Honduras, Brazil and Vera Cruz Sarsaparilla. Three of these are met with in bundles formed of folded roots, which are from twelve to twenty-four inches in length. The Brazilian variety has the roots unfolded, and the bundles are from three to five feet in length, by about a foot in

thickness. The roots consist of a rhizome (sometimes, however, wanting), and of numerous rootlets several feet in length, about the thickness of a writing quill, cylindrical, flexible, wrinkled longitudinally, with root fibres, in greater or less abundance, attached to them. Their colour varies, being more or less red or brown, often with a greyish tint. The taste of the root is mucilaginous, and, after chewing it for a few minutes, acrid. The odour is somewhat earthy.

Jamaica Sarsaparilla is considered the best. It has a lively red tint, and more attached rootlets than the other sorts. It is sometimes called *Red Sarsaparilla*. *Honduras Sarsaparilla*, said to be the most used in this country, is of a greyish brown colour, and has but few rootlets attached. The inner bark appears amylaceous, when broken. *Brazilian Sarsaparilla* resembles the last in colour and mealiness, but is almost free from rootlets, and the rhizome is not attached. *Vera Cruz Sarsaparilla* has a rhizome with numerous long radicles, is of a light, greyish brown colour, and without starch in the bark.

The sarsaparilla of the shops is often mixed with roots of allied species which do not possess any medicinal properties. Inferior kinds are also sometimes sold for those of better quality. We may thus, without taking into account the faulty mode of preparation, easily account for the difference of opinion which has prevailed in regard to the powers of this drug. The characters above given will afford the best means of ascertaining whether sarsaparilla is mixed with other roots. In regard to the quality of a particular sample, the only criterion which we have at present is the taste. If, when chewed for a short time, it leaves an acrid impression in the mouth, it may be considered efficient; if otherwise, it cannot be depended on.

The *False Sarsaparilla*, (*Aralia nudicaulis* L.,) often confounded with the true sarsaparilla, has a fragrant odour, and a warm, aromatic, sweetish taste.

SCAMMONY.

Scammonium, U. S.

This is the concreted milky juice of the *Convolvulus Scammonia* L., a native of Turkey, Syria, Greece, Egypt, &c. When pure, it is in irregular pieces, covered with a greyish white powder, friable, and easily broken into small fragments, with a shining greyish green fracture, soon passing into greenish black. Its powder is pale ash-grey. It readily forms a milky emulsion when rubbed with water. It has an odour resembling old cheese, and a taste somewhat acrid, but without bitterness. It leaves a slight residue when burned, and yields about 80 per cent. of its weight to sulphuric ether.

The form, however, in which this article commonly occurs, is in that of circular cakes five or six inches in diameter, and from an inch to two inches in thickness. It has a dark olive or slate colour approaching to black, internally somewhat lighter. It is easily pulverized, affords a light grey powder, and imparts to water a greenish milky appearance. It is adulterated with chalk, meal and starch. Dr. Christison found in the chalky specimens a proportion of carbonate of lime, varying from fifteen to thirty-eight per cent. ; in the amylaceous, from thirteen to forty-two per cent. of impurity ; and Neligan states, that in many specimens which he has examined, he has frequently found not more than from twenty-eight to thirty-five per cent. of resin. Effervescence in muriatic acid determines the presence of carbonate of lime ; while tincture of iodine gives the characteristic blue colour with starch.

A factitious scammony, manufactured in the South of France from the expressed juice of the *Cynanchum Monspeliacum* L. incorporated with various resins and other purgative substances, is sometimes imported into the United

States, and sold as Smyrna scammony. It is usually in flat semicircular cakes, four or five inches in diameter, and six or eight lines thick, blackish both externally and within, very hard, compact, rather heavy, of a somewhat shining and resinous fracture, a feeble balsamic odour wholly different from that of genuine scammony, and a very bitter, nauseous taste. When rubbed with the moistened finger it becomes dark grey, unctuous, and tenacious—(*U. S. Dispensatory*.) Pereira describes another factitious scammony, sold as Smyrna scammony, which is in circular flat cakes, about half an inch thick, blackish, and of a slaty aspect, breaking with difficulty, of a dull fracture, and of the specific gravity of 1.412. Moistened and rubbed, it has the smell of guaiacum, which may also be detected by chemical tests.

SCHEELE'S GREEN.

Arsenite of Copper.

This is a pulverulent arsenite of copper, prepared by adding the arsenite of potassa to sulphate of copper, both in solution in water, and afterwards filtering, washing and drying the precipitate. It is of a fine grass-green colour, and is used in calico printing, the manufacture of paper hangings, &c.

It is a virulent poison, and neither this nor the next article should ever be used for the colouring of confectionary. If it is necessary, for any purpose, to determine the presence of arsenic in this pigment, it can be done by mixing the substance with a portion of black flux, and subjecting it to heat in a green glass tube. When the experiment is properly performed, a sublimate of metallic arsenic will be produced, if the mixture contains arsenite of copper. The presence of copper may afterwards be proved, by dissolving the residue in nitric acid, and adding ammonia to the solution. If the solution contains copper, a fine blue colour will be produced.

SCHWEINFURT GREEN.

This is a mixture of acetate and arsenite of copper, or a compound of arsenious acid and oxide of copper in a peculiar state. It is a more beautiful and velvety pigment than the preceding; it may be tested in the same manner.—(See also the article CONFECTIONARY.)

SEALING WAX.

The best sealing wax is a mixture of four parts of pure shellac, and one or one and a half of Venice turpentine, with vermilion, lampblack or other substances, to give it the desired colour. An inferior quality is made by substituting rosin, in part or entirely, for the shellac, common turpentine for the Venice, and in the case of red wax, red lead for vermilion. Sealing wax thus made runs into thin drops when burning. In order to give a false appearance to the surface, the sticks are softened between two fires, and rolled in a box of powdered sealing wax of better quality; the sticks are then again softened between the fires to melt this coat, and give the wax the last polish.

SELENIUM.

This substance, at common temperatures, is a brittle solid, of a brown colour and metallic lustre, and has neither taste nor smell. It melts at a few degrees above the boiling point of water, and when warm is very ductile, and may be drawn out into very fine threads. Its vapour has a deep yellow colour. When heated in the flame of a candle urged by a current of air from a blow-pipe, it emits a strong smell of horse radish. It has not as yet been converted to any use, and is only an object of scientific curiosity. The preceding characters will enable any one to decide whether the specimen sold for selenium is in reality genuine.

SENNA.

Senna, U. S.

Under this name is included the leaves of several species of *Cassia*, as *C. obovata* Colladon, *C. acutifolia* Delile, *C. elongata* Lemaire, and *C. Æthiopica* Guibourt, natives of the north of Africa, particularly Egypt, of Arabia, and of the Indian Peninsula. They are also cultivated in the South of Europe, and in some of the West Indian Islands.

Of the varieties of senna known in commerce, those which are the most common are the Alexandrian, the Tripoli and the East Indian.

Alexandrian Senna, the produce of Nubia and Upper Egypt, is brought from the port whose name it bears, in large bales and barrels. It consists principally of the leaflets of the *C. acutifolia* and *C. obovata*, mixed with the leaves, flowers and fruit, of the Argel, *Cynanchum oleaefolium* Nees, and of the *Tephrosia Apollinea* Sprengel. This senna has a greyish green colour, an odour which resembles that of tea, and a viscid taste. The leaflets are much broken.

Tripoli Senna scarcely differs from the preceding. The leaflets are perhaps more broken, smaller, thinner, of a greener colour, and of a less herbaceous odour. It seldom contains either *Cynanchum* or *Tephrosia* leaflets.

East Indian Senna.—This occurs in large unbroken leaflets, from one to two inches long, and half an inch broad, thin and flexible, and of a fine green colour. Many of the leaflets, however, have a dark brown or blackish colour, probably from an imperfection in drying. Its odour and taste are similar to the Alexandrian senna.

Alexandrian senna, as before observed, is mixed with leaves of the Argel and of the *Tephrosia*. The former of

these are readily distinguished by their paler yellow colour, their coriaceous texture, their under surface being reticulated with veins, their upper surface being somewhat rugose, and by their being equal-sided ; the leaflets of all the true sennas being unequal at the base. Tephrosia leaflets are easily known by their silky surface, and by the lateral veins proceeding parallel to each other to the very edge of the leaf without ramifying.—(*Neligan.*) Burnett remarks, that the practice of mixing the argel with the senna has been carried to such an extent, as to persuade Nectoux that the real cathartic drug is argel, which the Alexandrian merchants *adulterate with senna*, in order to meet the demands of Europe, which always exceed by a third or more the annual crop. Rouillure, however, states that the traders at Cairo mix two parts of argel with three of the obovate, and five of the acute, leaved senna. The discrimination of these mixtures is a matter of consequence, as the argel is said to produce irritation of the bowels and protracted nausea.

In Europe there are said to be two other adulterations, which are not met with here. One is with the leaflets of *Colutea arborescens* L., or bladder senna, which may be readily distinguished by their regularity at the base. The other is with the leaflets of the *Coriaria myrtifolia* L., a poisonous plant growing in Southern Europe. It is said that in France accidents have happened from the administration of senna thus adulterated, and Mr. Fee states that when he visited the drug-warehouses at Lisle, Turcoing, Menin and their vicinities, in 1828, he found this adulteration almost universally practised. The fraud can be detected by an inspection of the leaves. Those of the *C. myrtifolia* are ovate-lanceolate, acute, greyish-green with a bluish tinge, three nerved, with a strongly marked midrib. Chemically, they are characterized by forming an abundant blue precipitate with sulphate of iron, and by giving precipitates with bichloride of mercury, tartar emetic and chloride of barium.

SILVER.

Argentum, U. S.

This metal has a beautiful white colour and lustre, being surpassed in this respect only by polished steel. It is very ductile and malleable. Its specific gravity is between 10.47 and 10.54. When pure it is so soft that it may be cut with a knife. It melts at a bright red heat, but is not oxidized by exposure to air or moisture. The tarnish of the polished metal in the air is occasioned by the formation of sulphuret of silver.

Silver is often mixed with various other metals, as gold, copper, lead, tin and nickel.

Detection of Gold, Copper and Lead.—These metals may be detected as follows: Dissolve the alloy in nitric acid a little diluted, with the aid of heat. Gold will remain undissolved as a dark coloured powder, if the acid is pure. From the nitric solution the whole of the silver may be thrown down by muriatic acid, as a white precipitate of chloride of silver, characterized by its becoming dark on exposure to the light, and by its complete solubility in ammonia. Filter the solution and add sulphuric acid; if it contains lead, a white insoluble precipitate of sulphate of lead will be formed. If copper is present, it can be detected by adding ammonia to the liquor filtered from the sulphate of lead, when the characteristic blue solution will be produced. Or if it is desired to obtain more accurate results, evaporate the liquor to which the sulphuric acid has been added, to dryness, and heat the dry mass sufficiently to expel the excess of sulphuric acid. Pour water over the residue, filter, wash, and dry the sulphate of lead. From the filtered solution deutoxide of copper may be precipitated, by caustic potassa, in the form of a blue hydrate, which, when boiled, becomes of

a brownish black colour. From this precipitate, when washed, dried and ignited, the proportion of copper may be determined.

Detection of Tin.—If silver contains tin, the latter metal will be converted into an insoluble peroxide by nitric acid, and may be separated by filtration. When, however, gold or platinum is also present, aqua regia must be employed to effect the separation instead of nitric acid. Both metals are thereby dissolved, and the peroxide of tin remains behind, if care be taken, previous to the filtration of the peroxide of tin, to destroy, as completely as possible, the free muriatic acid in the solution, by the addition of nitric acid.

Detection of Nickel.—Some counterfeit Mexican dollars have been recently put in circulation which are strongly suspected to have been issued from the mints in that country. Several of them were analyzed at the New Orleans Mint, and found to contain from 52 to 55 per cent. of silver and the rest copper, others were composed of silver, nickel and copper. The latter alloy may be analyzed as follows: Dissolve it in pure nitric acid slightly diluted, add muriatic acid to the solution; the silver will thus be entirely separated in the form of an insoluble chloride. Filter, and then pass through the clear acidulated solution a stream of sulphuretted hydrogen; the copper will be thrown down as a dark brown precipitate, while the nickel will remain in solution. After filtration, the latter metal may be precipitated, by potassa, in the form of an apple green hydrated oxide, insoluble in an excess of the alkali.

SILVER, CHLORIDE OF.

This compound, when formed by the addition of muriatic acid to a solution of a soluble salt of silver, is at first a white powder, but by exposure to the solar light it becomes violet

and almost black. It is wholly insoluble in water, and very sparingly dissolved by the stronger acids, but is soluble in ammonia and in boiling and concentrated solutions of chlorides of potassium, sodium and ammonium.

Chloride of silver has been proposed as a substitute for nitrate of silver in medical practice. It is said to be more certain in its effects, and not to produce the disagreeable result of discolouring the skin. If a sufficient quantity of water is employed in washing the chloride of silver, it may be easily obtained in a state of entire purity. Should adulterations be suspected, their presence may be indirectly determined by ascertaining the proportion of silver which any given weight of the chloride contains. The most simple process of reduction is that of Levöl, which is as follows : Boil the chloride in a solution of caustic potassa with some sugar. The silver is quickly reduced, is easily washed and obtained pure and in the state of powder. Carbonic acid is cooled during the reduction.—(*The Chemist, March, 1846.*) 100 parts of chloride of silver should yield about 75 parts of silver.

SILVER, CYANIDE OF.

Argenti Cyanuretum, U. S.

A tasteless white powder resembling chloride of silver, but differing from it in being soluble in hot nitric acid with decomposition. It is insoluble in water and the fixed alkalis, but readily soluble in ammonia. When carefully dried and subjected to heat in a glass tube, it yields cyanogen, and when treated with muriatic acid, it evolves hydrocyanic acid. It may contain copper, the presence of which can be determined by the blue colour produced upon the addition of ammonia to the nitric solution.

SILVER, NITRATE OF.

Argenti Nitras, U. S.

This salt, when pure, is in the form of white, tabular crystals, which ought to remain dry in the air, and when in

a dry state ought not to blacken by exposure to the light. When heated on charcoal it deflagrates. It is soluble in its own weight of cold, and in half its weight of boiling, water. Upon adding muriatic acid to the solution, an abundant white precipitate is produced, which darkens by exposure to the light, is insoluble in nitric acid, but entirely soluble in ammonia.

The *fused* nitrate of silver, or *Lunar Caustic*, is prepared by fusing the pure salt, and pouring it into heated moulds. In this state it should have the appearance of a grey or nearly white crystalline mass. It is usually, however, of a blackish colour, owing either to carelessness in the manufacture, or to the presence of organic matter, which under the influence of light causes a reduction of a portion of silver.

Nitrate of silver is often largely adulterated. Thus it contains free silver from having been exposed to too high a heat, the nitrates of lead and copper, from the impurity of the silver used in its preparation, and chloride of silver from that of the acid. From fraudulent admixture, also, it is sometimes contaminated with nitrate of potassa.

Detection of Free Silver and Chloride of Silver.—Dissolve the suspected lunar caustic in about its own weight of water. If it leaves more than a very slight dark residue, it contains either free silver or the chloride of silver. Add ammonia to this residue; the chloride of silver will be dissolved, while the free silver remains. From the ammoniacal solution the chloride may again be obtained by evaporation, and its amount determined. The free silver which remains after the separation of the chloride, may be dissolved in nitric acid and converted into a chloride by the addition of muriatic acid. Should any oxide of copper be contained in the insoluble residue, its presence will be detected by the blue colour caused on the addition of the ammonia.

Detection of Nitrates of Copper and Lead.—Dissolve a

known quantity of the suspected nitrate in a large quantity of water, and after having separated the insoluble matter by filtration, add muriatic acid. All the silver will be thrown down as an insoluble chloride, while the chlorides of copper and lead, if the quantity of water is sufficiently large, will be held in solution. Filter the liquid, and then add sulphuric acid; if any lead is present an insoluble sulphate of lead will be formed. From the filtered solution copper may be precipitated, if present, as deutoxide, by caustic potassa. The precautions which are required to effect this separation are described in the article SILVER.

Detection of Nitrate of Potassa.—To detect this salt, lunar caustic is to be dissolved in water, and the solution precipitated by muriatic acid as in the process for the detection of the metallic nitrates. The filtered solution is then to be neutralized with ammonia and treated with sulphuretted hydrogen to separate any metals which may be present. The filtered solution, if it contains nitre, will, on evaporation, leave a salt easily recognized by its properties as a nitrate. If thrown upon burning coals it will deflagrate and leave a fixed residue.

By operating upon a given weight of lunar caustic the proportions of the above adulterants may be easily determined. The real value of any sample may be accurately ascertained by dissolving it in water, precipitating it by muriatic acid, and determining the proportion of pure nitrate of silver by the weight of the dried and slightly heated chloride of silver. 100 parts of the nitrate of silver should give nearly 85 of the chloride of silver. An American dollar will yield nearly one ounce and a quarter of pure nitrate of silver.

SOAP.

In the most extended sense, the term *Soaps* embraces all those compounds which result from the reaction of salifiable

bases upon oils and fats. They are divided into soluble and insoluble ; the former being compounds of the oils with soda, potassa and ammonia ; the latter consisting of oils united with earths and metallic oxides. It is to the soluble kinds, however, that the name soaps is commonly applied, as these only are used in domestic economy. Some of the insoluble soaps are employed in pharmacy, as the soap of the protoxide of lead, and the soap of lime.

The soluble or common soaps are distinguished into two great classes, according to their consistence, viz., the hard and the soft. The former of these are produced by the action of soda upon fats, and the latter by that of potassa. But the consistence of soaps is somewhat influenced by the nature of the fats employed. Thus tallow, which contains much stearine and margarine, forms with potassa a more consistent soap than liquid oils do, which consist chiefly of oleine. The drying oils, such as those of linseed and poppy, produce the softest soaps.

A great many varieties of both hard and soft soaps are met with in commerce. They are known by various names, and their difference depends upon some peculiarities in the composition, or in the mode of manufacture, or both. All pure soaps, however, have the same general properties. Their smell is peculiar, and their taste is slightly alkaline ; they are somewhat heavier than water, but are entirely soluble in that liquid, especially when hot. Potassa soaps are more soluble than those which contain soda. Acids, added to a watery solution of soap, cause a milky appearance, in consequence of their combination with the alkali, and the diffusion of the oily substances through the water. Soaps are also soluble in cold, and abundantly in boiling, alcohol ; and this constitutes one of the best tests of their purity. The alcoholic solution, under the name of *Tincture of Soap*, is sometimes used for discovering earthy salts in mineral waters.

The substances most generally employed to adulterate the finer kinds of soap, are white clay, lime and gypsum. The presence of these substances, however, can be easily detected in one or other of the following ways: 1. Scrape an ounce of the suspected soap into thin shreds, pour boiling water over it in a basin, mix the whole till it forms a uniform paste, and then allow it to settle for about twelve hours near the fire. At the end of that time turn out the cake of soap. If any clay or gypsum has been used, it will be found on the under side. 2. Dissolve one part of the soap in six parts of alcohol, in a glass flask, by means of gentle heat. If either of these adulterants are present they will remain undissolved.

The dull red colour of certain fancy soaps is communicated by red ochre. If such soaps are dissolved in water, or in alcohol, the colouring material sinks to the bottom.

The common *Yellow* or *Rosin Soap*, often has a very offensive odour from the impure fats employed; and from the attempt to increase the proportion of rosin beyond the due limit, the alkaline matter preserves its peculiar acrimony, and acts injuriously upon all animal fibres to which it is applied. A little palm oil is usually employed in the manufacture of this soap, in order to correct the flavour of the rosin, and to brighten the colour. This soap, when well made, ought to be of a fine wax-yellow colour, transparent upon the edges of the bars, dissolve readily in water, and afford, even with hard well or pump water, an excellent lather.

One of the most serious, although usually overlooked, frauds practised with soap, is the large proportion of water which it often contains. If soap is sold in its recently manufactured state, great loss is incurred by the consumer from this cause. Dr. Ure states, that a contrivance was patented by Mr. Dunn, for making soap rapidly at a temperature of 310° F. under high pressure, by which many

credulous shareholders were induced to believe that they would realize large profits. "The soap so made was swelled in size and weight, by being surcharged with water, so that in a few weeks the bars of it shrunk, rent, and twisted into mere skeletons; and being in this plight returned to the company by their customers, caused that large soap bubble to burst."—(*Dictionary of Arts, &c., Suppl.*)

The officinal soap of the U. S. Pharmacopœia is made from caustic soda and olive oil. When properly prepared, it is tough, has a greasy feel and is free from alkalinity. It must dissolve in water, and give neither drops of oil, nor insoluble residue. If it contains lime, gypsum, or pipe-clay, these substances will remain undissolved.

SODA, ACETATE OF.

Sodæ Acetas, U. S.

This salt crystallizes in white, oblique rhombic prisms, which have a cooling, saline, and bitterish taste. It effloresces in a dry and warm air, and when subjected to heat undergoes watery fusion, and gives out its water of crystallization. At a red heat it is decomposed, and yields, as a residue, a mixture of charcoal and carbonate of soda. It is soluble in about three parts of water at 60° F., and in twenty-four parts of alcohol.

Acetate of soda should not change the colour of litmus or turmeric. If a sulphate be mixed with it, chloride of barium will cause a white precipitate, insoluble in nitric acid. If it contains a chloride, nitrate of silver will give a white precipitate insoluble in water, and in nitric acid, but soluble in ammonia. The deliquescence of the suspected acetate, the deposit of crystalline grains upon the addition of excess of tartaric acid, and the yellow precipitate, caused by the chloride of platinum, prove the presence of potassa.

This salt is used in the manufacture of acetic acid.

SODA, BIBORATE OF.

Sodæ Boras, U. S.—*Common Borax*.

This salt, when pure, crystallizes in oblique rhombic prisms, which are not efflorescent. It has a sweetish alkaline taste and reaction, although containing an excess of acid; soluble in twelve parts of cold, and two of hot, water. When exposed to heat it fuses and forms a transparent mass, called *glass of borax*. By this property it may be distinguished from alum and Rochelle salt, both of which it somewhat resembles.

Borax is sometimes adulterated with common salt and sulphate of soda, and occasionally with alum. If common salt is present, solution of nitrate of silver added to a solution of the suspected salt, will afford a white curdy precipitate of chloride of silver, insoluble in nitric acid. If the borax contains sulphate of soda, its solution will give a white insoluble precipitate with chloride of barium. The presence of alum may be detected by ammonia, which gives with that salt a bulky precipitate of alumina, but nothing of the kind with borax.

The amount of soda in borax may be estimated by observing how much free sulphuric acid must be added to the solution of borax to give it an acid reaction, in the same way that we employ the common alkalimetric process for determining the value of a specimen of carbonate of soda. As boracic acid does not change the blue colour of litmus to red, which sulphuric acid does, the smallest quantity of the latter, more than what is necessary to unite with the soda, may be shown by the litmus paper, and the amount added, until that point is attained, is proportional to the amount of soda or pure borax. (For the details of this process, see *Parnell's Elements of Chemical Analysis*.)

SODA, BICARBONATE OF.

Sodæ Bicarbonas, U. S.

This salt usually occurs in the form of a crystallized mass or of a whitish powder, but it may be obtained in oblique rectangular prisms. It has a slightly alkaline taste and is much less soluble than the carbonate, requiring thirteen times its weight of water at 60° F. for solution. When the solution is heated it gives out a part of its carbonic acid. By exposure to a low red heat it is rendered anhydrous.

As met with in commerce, the bicarbonate of soda is often mixed with a portion of the neutral carbonate. The presence of this salt may be determined by adding to the suspected mixture a small quantity of water, by which it will be dissolved. The solution, when filtered, if it contains carbonate of soda, will give a brick-red precipitate with corrosive sublimate, and a white one with sulphate of magnesia. In making this solution heat should not be applied, as it causes the change of a portion of the bicarbonate into the carbonate, and renders the above tests fallacious. The other impurities of this salt are similar to those found in the next, and may be detected by the same processes.

SODA, CARBONATE OF. (*Commercial*.)*Sodæ Carbonas Impura*, L.—*Barilla*, *Kelp*, and *Soda-Ash*.

The soda of commerce is known by the names of *Barilla*, *Kelp*, and *Soda-Ash*. The first of these is the result of the combustion of various plants growing on the shores of the Mediterranean; the second is procured by the incineration of various kinds of sea-weeds which grow upon the shores of Scotland, the Orkneys, the Hebrides, &c. Both of these varieties are very impure, and in their crude state are unfit

for most of the uses to which the alkali contained in them is applied. The soda-ash which is now so largely manufactured, is much purer, although it is still liable to considerable contamination.

These different kinds of impure carbonate of soda contain sulphates, sulphites, and hyposulphites of soda, besides carbonate of lime, caustic soda, alkaline chlorides and sulphurets.

Detection of Insoluble Matters, Chlorides, and Sulphates.—Dissolve a given weight of the soda-ash in two or three times its weight of water, filter the solution, and ascertain the weight of insoluble residue, which is principally carbonate of lime. Neutralize the solution with nitric acid *exactly*, and to separate portions of it add nitrate of silver, and chloride of barium. If a chloride is present the former test will give a white precipitate, soluble in ammonia; if a sulphate, the latter will give a white precipitate, insoluble in nitric acid. The soda-ash sometimes contains ten or fifteen per cent. of chloride of sodium and sulphate of soda.

Detection of Sulphuret of Sodium, Sulphite and Hyposulphite of Soda.—Add some of the suspected soda-ash to dilute sulphuric acid, coloured reddish yellow, with bichromate of potassa, the alkali not being added in sufficient quantity to saturate the acid. If the above salts are present, the reddish yellow colour is changed to green, owing to the deoxidation of the chromic acid and formation of oxide of chromium. Soda-ash, which contains sulphuret of sodium, gives a black precipitate with a solution of acetate of lead, and disengages the odour of hydrosulphuret of ammonia when moistened with a solution of common carbonate of ammonia.

Detection of Caustic Soda.—A convenient test for this

purpose is a solution of nitrate of silver, which gives a *white* precipitate with a solution of an alkaline carbonate, containing no caustic alkali, but a *brown* precipitate with a caustic alkali, or a mixture of a caustic and carbonated alkali. Another method consists in adding an excess of perfectly neutral chloride of barium to the soda-ash, treating the mixture with hot water, and filtering; if the filtered liquid produces an alkaline reaction on test-paper, the presence of caustic soda may be inferred. It is of consequence in some alkali-metrical processes to determine the presence and proportion of this caustic alkali.

The true test of the value of any sample of carbonate of soda is its saturating power. One mode of determining this fact is similar to that described under the head of CARBONATE OF POTASSA, with due allowance for the difference in the proportions of the two alkalies which are required to saturate a given amount of any acid. Owing to the presence of some impurities in the soda-ash, this test is not to be altogether relied on. Descriptions of a more accurate method will be found in *Parnell's Applied Chemistry*, and in the *Supplement to Ure's Dictionary of Arts, &c.*

SODA, CARBONATE OF.

Sodæ Carbonas, U. S.

This salt crystallizes in oblique rhombic prisms, which effloresce on exposure to the air, and when heated undergo watery fusion and become anhydrous. It is soluble in about two parts of cold¹, and in less than their weight of boiling water, and the solution has a strong alkaline taste and reaction.

The carbonate of soda is distinguished from the bicarbonate, by the brick-red precipitate which it produces with corrosive sublimate, and the white precipitate with sulphate of magnesia.

Carbonate of soda is sometimes adulterated with sulphate of soda, chloride of sodium, and traces of iron. The two former substances may be detected in the mode pointed out in the preceding article. If iron is present, it will either be found as an insoluble residue when the salt is dissolved in water, or may be detected by the blue precipitate produced upon the addition of ferrocyanide of potassium to a solution of the suspected carbonate neutralized by an acid.

SODA, HYPOCHLORITE OF.

Liquor Sodæ Chlorinata, U. S.—*Labarraque's Disinfecting Soda Liquid*—*Chloride of Soda*.

The above names have all been applied to a compound formed by passing chlorine into a solution of carbonate of soda, or by mixing chloride of lime with solution of carbonate of soda, setting the mixture aside and afterwards decanting the clear liquid. It has a pale yellow colour, and a sharp, saline, astringent taste.

This compound contains, besides the hypochlorite of soda, variable proportions of chloride of sodium, carbonate and bicarbonate of soda, depending upon the particular process which is employed in its preparation. It is more stable than the corresponding potassa compound, although it is liable to change by long keeping. Its use depends upon the evolution of chlorine, and its value may be determined in the same manner as that of hypochlorite of lime.

SODA, HYPOSULPHITE OF.

This salt occurs in large and regular crystals, which deliquesce in the air and are very soluble in water. It has a bitter and nauseous taste, and when heated dries and takes fire, deflagrating with a yellow flame. It is insoluble in alcohol, which precipitates it from its aqueous solution. It

has the property of dissolving the chloride, iodide, and bromide of silver, and is hence used in the Daguerreotype process. From the mode of manufacture which is now adopted, it is apt to contain lime, or the hypochlorite of lime.

SODA, NITRATE OF.

Cubic Nitre.

This salt, found in large quantities in Peru, has recently come into use as a manure, and as a substitute for nitrate of potassa in the manufacture of nitric and sulphuric acids. In its native state it occurs in masses, having a granular structure from irregular crystallization, and a white, grey, or reddish brown colour. Besides nitrate of soda, this mineral contains sulphate of soda, chloride of sodium, and iodic salts. When purified by a re-crystallization it forms obtuse rhombohedrons, having a taste somewhat bitter, and slightly deliquescent in moist air. It is soluble in about two parts of cold water, and in less than its own weight at 212° F. When thrown upon burning coals it gives rise to an orange yellow flame. By these characteristics this salt may be distinguished from nitrate of potassa, for which it has sometimes been sold.

SODA, PHOSPHATE OF.

Sodæ Phosphas, U. S.

It occurs in colourless oblique rhombic prisms, always alkaline to test-paper, superficially efflorescent and soluble in about four parts of cold, and two of hot, water. It has a cooling, slightly saline taste.

If the solution of this salt effervesces upon the addition of an acid, it contains carbonate of soda. The solution must not become turbid on being heated with ammonia. The

precipitates produced by the addition of solution of nitrate of silver and chloride of barium must completely re-dissolve on the addition of dilute nitric acid, otherwise it contains common salt and sulphate of soda, at least if the absence of a carbonate has been secured by the previous addition of a slight excess of nitric acid.

SODA, SULPHATE OF.

Sodæ Sulphas, U. S.—Glauber's Salt.

This salt crystallizes in four and six-sided prisms, which effloresce rapidly upon exposure to the air. It undergoes watery fusion when heated. 100 parts of water dissolve 48 parts of the salt at 64.5° , and 322 parts at 91.5° ; but when the water is further heated a portion of the salt is deposited, in consequence of its being less soluble than at 91.5° .

Detection of Acids, Alkalies, and Chloride of Sodium.—If this salt contains an excess of acid, which is sometimes the case from the mode of its manufacture, its solution reddens litmus paper. If it contains an excess of alkali, it changes the yellow of turmeric to brown. Chloride of sodium may be detected by the white precipitate, insoluble in nitric acid, caused by solution of sulphate of silver. The presence of iron is rendered evident by the blue precipitate produced on adding the solution of ferrocyanide of potassium.

Distinction between Nitrate of Potassa and Sulphate of Soda.—Nitrate of potassa has sometimes been mistaken for sulphate of soda, and serious, and in some cases fatal, accidents have thus occurred. The two salts may be easily distinguished by the following tests: Sulphate of soda, on being moderately heated, is freely dissolved in its own water of crystallization, while for the fusion of nitrate of potassa a

heat of upwards of 600° F. is required. A little powdered nitrate of potassa thrown upon hot coals causes a violent deflagration, which is not the case with the Glauber's salt. A solution of sulphate of soda, moreover, gives a white precipitate with a solution of chloride of barium, while nitrate of potassa, does not.

SODA WATER.

This term was formerly applied to water strongly charged with carbonic acid, and containing a small quantity of carbonate of soda; but what is now known by the name of "soda water," is nothing more than a solution of carbonic acid in pure water. (See CARBONIC ACID WATER.)

When soda water is pure it is not discoloured by sulphuretted hydrogen nor solution of ammonia, and yields no precipitate with sulphuric acid, nor with ferrocyanide of potassium. When made in metallic fountains, and especially when allowed to remain in them for any length of time, the water often contains some impurities, the presence of which can be detected by the above tests. A case of colica pictorum is mentioned as having arisen from the daily use of the first draught of carbonic acid water from a fountain furnished with tubes of lead.—(*U. S. Dispensatory.*)

A fraudulent imitation of soda water is said to have been practised, by adding a few drops of sulphuric acid to a solution of carbonate of soda, and instantly corking the bottle. This fraud may be detected by adding chloride of barium to a portion of this water until precipitation ceases. On treating this precipitate with diluted nitric acid, if any portion remains undissolved, it proves the presence of sulphuric acid in the solution.

SODIUM, CHLORIDE OF.—*See* COMMON SALT.

SODIUM, IODIDE OF.

This substance occurs in flat rhomboidal prisms, which, when heated, fuse and lose their water of crystallization. 100 parts of water at 60°F. dissolve 173 of this iodide. The solution should be colourless and should give a fine yellow precipitate with solution of nitrate or acetate of lead, and a red precipitate with a solution of nitrate of mercury.

SODIUM, PROTOXIDE OF.

Hydrate of Soda—Caustic Soda.

A greyish white, brittle substance, very caustic, possessed of powerful alkaline properties, easily fused by heat, and readily soluble in water and alcohol. When exposed to the air it becomes covered with an efflorescent crust, by which it can be distinguished from potassa, which deliquesces. It should be kept in well-closed bottles.

The usual impurities of common caustic soda are carbonate of soda, sulphate of soda, and chloride of sodium. The first of these is detected by the effervescence of its solution upon the addition of an acid. If when a solution of the suspected substance is exactly neutralized by nitric acid, nitrate of silver causes a white precipitate, it is probably owing to the presence of common salt. If chloride of barium causes a white precipitate in the same solution, it proves that it contains a sulphate.

SPANISH FLY.—*See* CANTHARIDES.

SPERMACETI.

Cetaceum, U. S.

A peculiar concrete substance obtained from the spermaceti whale, *Physeter macrocephalus*. It is in white, pearly, semi-transparent masses, having a crystalline foliaceous texture; it is friable and somewhat unctuous. Its specific

gravity is 0.943 at 60° F. It is insoluble in water ; but boiling alcohol dissolves it in small quantity, and ether in a much larger proportion. It melts at 212° F.

A more or less impure mixture of stearic and margaric acids is now extensively used as a substitute for spermaceti and wax, in the manufacture of candles. For this purpose tallow is saponified by lime, the insoluble soap which results decomposed with diluted sulphuric acid, and the oily portion separated by pressure from the acidified fat. These so called "Stearine candles" formerly contained a minute proportion of arsenious acid which was added to counteract the disposition of the acid to crystallize on cooling. This deleterious substance is not, however, at present introduced. These candles, when properly made, are white and inodorous, and burn with a pure white flame. Their combustion, however, is said to be a little more rapid than that of wax.

Stearic acid may be distinguished from spermaceti by its more free solubility in alcohol and by its higher fusing point.

STARCH.

Amylum, U. S.

This well-known substance is obtained from the grains of the various cereals and from potatoes, and is found to a greater or less extent in almost all plants. In a state of purity it is a fine, tasteless and inodorous powder. It gives a peculiar noise when squeezed between the fingers, and feels slightly crystalline. It is insoluble in cold water, in alcohol, and in ether. In boiling water, starch resolves itself into a mucilaginous liquid which forms a jelly on cooling. The recent solution is coloured deep blue by tincture of iodine, but after a short boiling iodine produces a purple colour, and if the boiling be continued the colour entirely disappears.

The principal varieties of starch are the following, viz :

Common starch, derived from the grains of cereals, especially of wheat.

Potatoe starch, derived from the tubers of the potatoe.

Arrow-root, derived mostly from the roots of the *Maranta arundinacea* L.

East Indian arrow-root, chiefly from the tubers of the *Curcuma angustifolia* Roxb.

Sago, derived from the pith of palms of the genus *Sagus*.

Cassava and tapioca, derived from the tuberous root of the *Jatropha Manihot*.

Indian corn starch, derived from the *Zea Mays* L.

Salep, supposed to be derived from the roots of the different species of *Orchis*.

Tous les mois, supposed to be obtained from *Canna coccinea*.—(*Parnell*.)

Most of these varieties are noticed in this work under the appropriate heads, (See ARROW-ROOT, CANNA STARCH, SAGO, SALEP and TAPIOCA ;) and I shall here only introduce some facts in regard to wheat and potatoe starch.

Wheat starch, when examined by a microscope, is found to consist of particles having for the most part a rounded shape and an uneven surface, and varying considerably in size. The hilum is surrounded by concentric rings, but is very indistinct, until a gentle heat is applied to the water in which the particles are placed.

Potatoe starch, in its ordinary state, is more pulverulent than wheat starch, has a somewhat glistening appearance, and may be distinguished, with the aid of the microscope, by the size of its granules, which are larger than those of any known variety except the canna starch. They are very various in shape and size, but the regular form is thought to be ovate. They have concentric rings or rugæ, distinctly seen when the starch is fresh, surrounding a minute circular hole or hilum upon the surface of the granule.

Sometimes there are two of these holes ; one at each end, or both at the same end.

The starch met with in commerce is seldom free from moisture. The quantity of water varies according to the temperature and the humidity of the air. According to M. Payen, potatoe starch absorbs water from an atmosphere perfectly saturated with moisture, until it has acquired twenty-three per cent. It is much more hygrometric than other kinds of starch, and hence not so well adapted for stiffening linen, &c.—(*Parnell's Applied Chemistry*.) The proportion of moisture in any sample may be determined, by drying a known weight of it in a vapour bath, and noting the loss. Starch is often, also, adulterated with gypsum, chalk, and argillaceous substances. These may be easily detected by the incineration of a small quantity of the suspected starch. Unadulterated starch leaves scarcely a trace of earthy matter. If a dirty scum floats on the surface of the water, when starch is stirred with that liquid, it contains other impurities. It is sometimes tinged blue by smalt or indigo ; but such starch should never be used as food or medicine.

Parnell states, that a few years ago potatoe starch was employed, to a pretty large extent, to adulterate wheat starch ; and the price of the former was then so low that a profit of twenty per cent. was realized by the sophistication. But since the numerous applications of potatoe starch have increased the value of this substance this adulteration has not been much practised.

STORAX.

Styrax, U. S.

This is the concrete juice of the *Styrax officinale* L., a native of the Levant, and cultivated in the South of

Europe. A great many varieties are described, two of which are generally met with, viz.: *Common* and *Liquid Storax*. The former is in very friable, reddish brown masses, with an agreeable, aromatic odour, and a warm, somewhat acrid taste. The latter is a viscid liquid, of a brown, or almost black, colour on the surface, slightly greenish grey within, and having an aromatic odour. Another variety of liquid storax occurs which has the odour of naphtha.

A great many different substances are sold under the name of Storax. The common storax, above mentioned, appears to be sawdust cemented by the real balsam of the styrax or some analogous substance. One variety of the so called liquid storax is supposed to be some compound of impure naphtha. The real storax contains a volatile oil, benzoic acid and a resinous extractive. It yields its active properties to alcohol and ether; but merely its fragranciness to boiling water. It is at present seldom used.

STRONTIUM, CHLORIDE OF.

This salt crystallizes in colourless prisms which deliquesce in a moist atmosphere. It is soluble in twice its weight of water at 60° F., and in less boiling water. Soluble also in alcohol, to the flame of which it gives a blood-red colour.

Detection of Chloride of Barium.—Chloride of strontium is often adulterated with chlorides of barium and calcium. Dissolve the suspected salt in water, and add solution of sulphate of strontia. If chloride of barium is present, a white precipitate of sulphate of baryta will be produced. Or evaporate the mixed chlorides to dryness, and digest the residue in strong alcohol. Chloride of strontium is dissolved, and may be recognized in this solution by the crimson colour of its flame, and by its forming a white precipitate, with dilute sulphuric acid.

Detection of Chloride of Calcium.—Add to a solution of the suspected salt, in a large quantity of water, sulphuric acid, drop by drop, until precipitation ceases. Filter, neutralize the clear liquor by ammonia, and add solution of oxalic acid, or of oxalate of ammonia. If a white precipitate is produced which is insoluble in acetic acid, it proves the presence of lime, and we infer that chloride of calcium was mixed with the chloride of strontium. If the salt contains iron, the addition of the ammonia, in the preceding process, will cause a precipitate which, after a short exposure, becomes red brown.

STRYCHNINE OR STRYCHNIA.

Strychnia, U. S.

This is one of the vegetable-alkalies, obtained from the seeds of the *Strychnos Nux vomica* L., a native of the East Indies. When entirely pure, it occurs in the form of small, white four-sided prisms or octahedrons. It is soluble in 2,500 parts of boiling water, and in about 7,000 of cold water, yet the last solution is intensely bitter. It is almost insoluble in absolute alcohol and ether, but is sensibly soluble in spirit of wine. It is fusible, and easily decomposable by heat, but is not volatile.

The following is a test, by which, according to M. Marchand, a very minute proportion of strychnine may be detected: If a little of the alkali be rubbed with a few drops of concentrated sulphuric acid containing one-hundredth of nitric acid, it will be dissolved without change of colour; but if the least quantity of peroxide of lead be added to the mixture, a magnificent blue colour will be instantly produced, which will pass rapidly into violet, then gradually to red, and ultimately becomes yellow.—(*The Chemist*, Oct., 1844.)

As it is ordinarily met with in commerce, strychnine is

in the form of a dirty white granular powder, and is seldom free from brucine and colouring matter. It sometimes, also, contains lime or magnesia.

Detection of Brucine.—When strychnine is mixed with brucine, which is also one of the active principles of the *Nux vomica*, it will be reddened by nitric acid, and the colour changed to violet on the addition of protochloride of tin. Chloride of gold is said, also, to produce, with solutions of the salts of brucine, precipitates at first milky, then coffee coloured, and finally chocolate brown.

Detection of Lime or Magnesia.—By adding spirit of wine to the suspected strychnine, the alkali will be dissolved, but the lime or magnesia, if present, will remain. These will also form a fixed residue upon the application of heat to the suspected mixture.

Distinction between Strychnine and Morphine.—Morphine, for the salts of which strychnine has been administered with fatal results, is reddened by nitric acid, but on the addition of the protochloride of tin, the colour is discharged. Morphine, also, strikes a deep blue with a neutral solution of perchloride of iron, which is not the case with strychnine.

Nux Vomica, when in powder, is of a greyish yellow colour, and yields its virtues to water and diluted alcohol. According to Christison it is frequently adulterated with common salt, which may be detected by treating the powder with cold water, filtering, evaporating and crystallizing. As a medicinal article it has been, in a great measure, replaced by strychnine.

SUCCINIC ACID.

This acid, in the form of a hydrate, crystallizes in small, colourless, translucent prisms. It has a slightly sour taste ;

is soluble in three parts of boiling, and in five parts of cold, water. At 450° F. it sublimes. It is scarcely soluble in spirit of turpentine, by which, as well as by the difference in taste, it may be distinguished from benzoic acid.

As it occurs in commerce, it is often adulterated with tartaric acid, bisulphate of potassa, and sal ammoniac. Tartaric acid is discovered by the carbonaceous residue which it leaves when heated; the sulphate of potassa, by its want of volatility; and sal ammoniac, by the odour of ammonia which it gives out when rubbed with lime, or by the action of the salts of silver upon a solution of the suspected succinic acid.

SUGAR.

Saccharum, U. S.

The substance, commonly known under this name, is the produce of the sugar-cane, *Saccharum Officinarum*, which is extensively cultivated in both the East and West Indies, and in the southern parts of the United States. The two principal varieties are *Purified* or *White sugar*, and *Unpurified* or *Brown sugar*. The former of these occurs in concrete, somewhat porous masses, consisting of an aggregate of small crystalline grains. When properly refined it is perfectly white, inodorous, and has a pure saccharine taste. The brown sugar, of which there are again numerous subvarieties, is in the form of a coarse powder, more or less moist and sticky, consisting of grains of various sizes, intermixed with lumps, having a very sweet taste and a peculiar smell. The best kinds are those which have sharp, bright, hard and loose grains, and a clear brownish colour. Those which are very soft and close grained, though they may be whiter, are inferior.

The brown sugars are said to be sometimes adulterated with various foreign substances, as sand, plaster, chalk, flour

and potatoe starch. The three former of these are at once precipitated during the solution of the suspected sugar in water, while farina and starch give a milky appearance to the liquid which disappears slowly. The nature of the suspected substance may at once be determined if a fine blue colour is produced by a few drops of tincture of iodine. Incineration may also be employed as a means of detecting the presence of any foreign inorganic matters.

It is not probable that the above adulterations, in consequence of their easy detection, are much practised. Exposure to a moist atmosphere may so largely increase the amount of water in sugar, as to constitute an important adulterant. The proportion of water in any sample may easily be ascertained by subjecting a weighed portion to a moderate heat. Sugar ought not to lose by this operation more than ten or twelve per cent., but in many cases, I doubt not, the loss would range from twenty to twenty-five per cent.

But the adulteration which is now most generally practised, consists in the addition of *Glucose*, or *Starch sugar*, to the sugar of the cane. The manufacture of this article has long been carried on in France, Belgium and Holland, and has recently been introduced in England. This variety of sugar is obtained at a comparatively cheap rate by the action of sulphuric acid upon the starch of coarse potatoes, although a substance identical in composition and properties is procured from various other sources. It is found in honey and in sweet grapes; indeed it constitutes the sweet principle of most of our fruits.

Grape sugar differs from cane sugar in several important particulars. Its taste is much less sweet, and is somewhat farinaceous or mucilaginous. According to Dumas, its sweetening power is as forty to one hundred of cane sugar. Starch sugar is less soluble in water, requiring one and a half

parts of the cold liquid for solution. Its mode of crystallization is also entirely different; instead of forming like cane sugar, bold and distinct crystals, it separates from its solutions in granular warty masses, which rarely present crystalline faces. It fuses at 212° F. and loses about nine per cent. of its weight; when heated to 284° F. it is converted into caramel. Cane sugar requires a heat 356° F. for fusion, and is converted into caramel at 410° or 428° F.

To show the extent to which the adulteration of cane sugar by starch sugar is carried, it is perhaps enough to refer to the fact stated by Garnier and Harel, that some raw sugar exported from France to certain ports in the Mediterranean, yielded only thirty per cent. of refined sugar. The rest was a kind of molasses, the syrup of starch sugar, which was almost worthless. Raw sugar always contains a certain quantity of molasses, but this is of good quality, and a certain proportion of refined sugar can be obtained from it. This mixture of raw cane sugar and molasses yields from sixty to sixty-five per cent. of refined sugar. The loss, therefore, which the refiners suffered from the frauds thus practised was very great.

An article similar to that just mentioned was introduced into England from Rotterdam, under the name of "Vegetable Juice." On examination it was found to be imperfectly saccharified starch, or fecula, which was not susceptible of granulation, but became, upon being heated, a concrete, though very deliquescent mass.

According to Dr. Ure, a good criterion of such incompletely formed sugar is, its resisting the action of sulphuric acid, while perfectly saccharified starch or cane sugar is readily decomposed by it. If into a strong solution of imperfectly saccharified starch sugar, nearly boiling hot, one drop of strong sulphuric acid be let fall, no perceptible change will ensue, but if the acid be dropped into solutions of either of

the two sugars, black carbonaceous particles will make their appearance.—(*Dictionary of Arts, &c. Suppl.*)

The manufacture of starch sugar has been recently so much improved that it can now be made closely to resemble cane sugar in its appearance. But its mixture with cane sugar is always fraudulent, and it therefore becomes important to have the means of detecting the adulteration.

Detection of Starch Sugar.—The difference between starch sugar and cane sugar in regard to their solubility, crystallization and the effect of heat has already been noticed. Several other tests have been proposed to discriminate between two kinds of sugar, but the most delicate is that of M. Trommer. It consists in adding to solutions of the sugars, rendered alkaline by caustic potassa, a saturated solution of sulphate of copper—deep blue liquids are obtained, which, on being heated, exhibit different characters. The one containing cane sugar is at first but little altered; a small quantity of red powder falls after a time, but the liquid long retains its blue tint. With the starch sugar, on the other hand, the first application of heat throws down a copious greenish precipitate which soon changes to an orange, leaving a nearly colourless solution.

If the suspected sugar, therefore, when examined by this test, is found to give a sensible precipitate of suboxide of copper in the cold, after standing a few minutes, or immediately on the application of heat, it is a proof that the adulteration has been practised. This test, according to Trommer, is so delicate that a solution containing no more than a hundred thousandth part of starch sugar affords a sensible yellowish red precipitate.

The modification of this test proposed by Dr. Ure, is to dissolve a weighed portion of sulphate of copper in a measured quantity of water, and to make the solution *faintly* alka-

line, as tested with turmeric paper, by the addition of potassa, in the cold ; for if the mixture be hot, a portion of the disengaged green hydrate of copper is converted into black oxide. This mixture, being always agitated before applying it, forms the test liquor. If a few drops of it are added to a solution of cane sugar, no change is perceived in the cold at the end of two days ; and very little change of colour, even at a boiling heat, if not too concentrated. But if the same addition is made to a solution of starch sugar, a copious green precipitate is produced which rapidly changes to an orange colour. With this alkaline mixture, Dr. Ure states that he has never failed of discovering an exceedingly small proportion of starch sugar, even when mixed with Muscovado sugar ; and thus an excellent method is afforded of detecting the frauds of grocers.—(*Dictionary of Arts, &c. Suppl.*)

It is estimated that not less than forty millions of pounds of foreign substances are annually mixed with the sugar consumed in Great Britain.

MAPLE SUGAR.—This is a kind of sugar obtained by the evaporation of the juice of the *Acer Saccharinum L.*, and its preparation is a domestic manufacture of considerable importance. Its taste is equally agreeable as that of cane sugar, and by some is even preferred. It possesses the properties of cane sugar, sweetens as well, and is identical with it in composition. When refined, it is as white and granular as loaf sugar.

Maple sugar is most commonly met with in cakes of various sizes, having a dark brownish colour. It usually contains a portion of iron derived from the kettles in which the evaporation is conducted ; this causes it to give a dark colour with an infusion of tea. For a year or two past many samples have been quite largely adulterated with

sand and other foreign matters. Most of these can be detected by the residue left on the solution of the suspected sugar in water.

SULPHUR.

Sulphur, U. S.—Brimstone.

This substance occurs in commerce in three different forms, viz.: *crude sulphur*, *roll sulphur*, and *flowers of sulphur* or *sublimed sulphur*. It is of a light yellow colour, has little taste, and melts at a heat of from 216° to 220° F. It is soluble in ten times its weight of boiling oil of turpentine, and is converted into vapour at from 550° to 600° F.

Sulphur is often adulterated with various earthy matters, as silica, alumina, magnesia, &c. The presence and proportion of these may be determined by boiling the suspected sulphur in about ten times its weight of oil of turpentine, as long as anything is dissolved. What remains consists of impurities, which may be separated by filtration and weighed. Or by applying heat to a portion of the suspected sulphur in a small porcelain dish, the pure sulphur will be entirely consumed, while the earthy matter remains.

A peculiar bituminous substance is also sometimes found in sulphur. The presence of this may be determined by the fetid odour which the suspected sulphur gives out on being inflamed, or even on being strongly rubbed. The residue of the dry distillation of bituminous sulphur, contains a quantity of charcoal resulting from the decomposition of the bitumen, and the distilled sulphur has often a reddish appearance on account of the presence of a portion of bitumen.

Detection of Arsenic.—Arsenic in the form of sulphuret, is sometimes found in the sulphur obtained from iron pyrites. It is unnecessary to say that the presence of this substance

is a matter of serious importance. One process for its detection, if it exists as a sulphuret, is the following: A certain quantity of the suspected sulphur finely pulverized, is to be digested with a solution of ammonia for a considerable time, then filtered, and the clear liquid afterwards treated with muriatic acid in excess. If a yellow precipitate occurs, it is an indication of the presence of arsenic (the sulphuret of arsenic being soluble in ammonia); but if not, the liquid is to be evaporated until only a few drops remain. A little ammonia is then to be added; afterwards a small quantity of muriatic acid; and finally a little solution of sulphuretted hydrogen. If there is the smallest quantity of arsenic, it will be rendered evident by a yellow precipitate, from which the metal may be obtained by the processes of reduction already described.—(See the article *ANTIMONY*.)

Another mode of detecting arsenic in sulphur is to heat the suspected mixture with nitromuriatic acid. The arsenic, if present, will be converted into arsenic acid; and the acid solution, diluted with water, neutralized with carbonate of soda, and again acidulated with muriatic acid, will give a yellow precipitate of sulphuret of arsenic with a stream of sulphuretted hydrogen.

Sublimed Sulphur, when examined by a microscope, appears composed of minute crystals. It is almost always sour, owing to the formation of a little sulphurous acid during the process of sublimation. This is subsequently converted into sulphuric acid, and may be removed from the sulphur by washing it with hot water; a process which should never be neglected when it is to be employed medicinally. The presence of this acid may be determined by testing the clear solution with litmus paper and a solution of chloride of barium. The litmus paper will be changed from blue to red, and the chloride of barium will cause a white precipitate, insoluble in nitric acid.

SULPHUR, PRECIPITATED.

Sulphus Præcipitatum, U. S.—*Lac Sulphuris* or *Milk of Sulphur*.

This is prepared by boiling together in water slacked lime and sublimed sulphur, filtering the solution and treating it with a sufficient quantity of muriatic acid to precipitate the whole of the sulphur, which is collected and dried in a stove.

The common mode of manufacturing this article is by the employment of sulphuric, instead of muriatic, acid. It is, in consequence, largely adulterated with hydrous sulphate of lime, the proportion of which sometimes amounts to two thirds of its weight. This adulteration is readily detected by subjecting the suspected mixture to heat, when the sulphur and water of crystallization are volatilized, and the sulphate of lime remains behind.

SULPHUR, IODIDE OF.

Sulphuris Iodidum, U. S.

This compound is prepared by thoroughly mixing together iodine and sulphur, and subjecting the mixture to gentle heat. It has a black colour and radiated crystalline appearance, like sulphuret of antimony. It is decomposed by a heat a little above that at which it is formed; and when boiled in water, the iodine goes off with the steam, and the sulphur remains.

SULPHURIC ACID.

Acidum Sulphuricum, U. S.—*Oil of Vitriol*.

Sulphuric acid, as it ordinarily occurs in commerce, is a colourless, dense, oily, powerfully corrosive liquid. It has

a very sour taste, reddens the blue colour of litmus, even though largely diluted with water, and has a specific gravity, in its most concentrated form, of 1.845 at 60° F., being nearly twice as heavy as water. Its presence may always be detected by the white precipitate, insoluble in nitric or muriatic acid, which it forms when added to any soluble salt of baryta.

Various impurities occur in the commercial sulphuric acid; as, organic matter, the sulphates of lime, potassa, lead and tin, arsenious acid, and several compounds of oxygen and nitrogen. Sometimes, also, it contains so large a quantity of water as to render it unfit for many uses. The presence and proportion of these saline matters may be determined by heating a portion of the suspected acid in a platinum crucible. The pure acid will be entirely volatilized, but the salts if there are any, will remain and may be subsequently examined. The ignition of the residue must be carefully conducted out of contact of air, as a portion of sulphate of lead may otherwise be volatilized. Its presence may then be detected by its being blackened by a solution of sulphuretted hydrogen or the hydrosulphuret of ammonia. Sulphates of lime and potassa, if present, may be dissolved by a sufficient quantity of hot water, and the solution tested by oxalate of ammonia, chloride of barium, and the chloride of platinum.

Sulphate of tin is frequently found in the sulphuric acid of commerce from the action of the acid upon the solder of the chambers. The English sulphuric acid also often contains arsenic, probably from the source referred to in the article SULPHUR. It is said that in some specimens there has been found as high a proportion as one grain of arsenious acid to a fluid ounce of the sulphuric acid. Mr. Brittain, a chemist, after inhaling 150 cubic inches of hydrogen, to ascertain the change of voice which it would produce, died in five days with the symptoms of poisoning by arsenic, and on ex-

amination the acid employed was found to contain arsenic, which formed arseniuretted hydrogen. (*The Chemist*, iii., 89.)

Tin will probably seldom occur as an adulterant of sulphuric acid, if the mode lately introduced of joining the leaden plates of the chambers with the oxyhydrogen blow-pipe, is generally adopted.

Detection of Tin and Arsenic.—The complete separation of tin and arsenic is difficult; but the two metals may be detected in sulphuric acid by the following process: Dilute a portion of the acid with six or seven times its weight of water, and pass a current of sulphuretted hydrogen through the liquid. Should a yellow or brownish precipitate be produced, either immediately or at the end of several hours, separate it by filtration, and after drying, treat it with nitric acid slightly diluted. Arsenic, if present, will be dissolved as arsenic acid, while the tin will remain in the form of a white insoluble peroxide. The filtered solution may afterwards be treated with sulphuretted hydrogen, the sulphuret of arsenic separated by filtration, and reduced to the metallic state. The insoluble residue left after the action of the nitric acid, may be fused in a platinum crucible with thrice its weight of dry carbonate of soda and afterwards dissolved in diluted muriatic acid. From this solution the peroxide of tin may be precipitated as a yellow sulphuret by a current of sulphuretted hydrogen, and the precipitate again converted into the insoluble peroxide by the action of nitric acid.

An easy and delicate process for the detection of arsenic alone in sulphuric acid is to introduce a portion of the acid, much diluted, along with some pure zinc, into a glass bottle accurately fitted with a cork through which passes a small tube, (Marsh's apparatus.) After the gas is freely evolved the jet may be fired and a porcelain plate held over the

flame. If any arsenic is present in the acid, a deposit of metallic arsenic will be formed, from the decomposition of the arseniuretted hydrogen. In this experiment the absence of arsenic in the zinc should be previously ascertained, and care should be taken not to breathe the gas evolved.

Detection of the Compounds of Nitrogen and Oxygen.—Permanganate of potassa is a good test of deutoxide of nitrogen or nitrous acid in sulphuric acid, diluted with about six parts of water. If either of these substances is present, the permanganate is decolourized, but no such effect is produced by the presence of pure nitric acid in dilute sulphuric acid. If a crystal of protosulphate of iron be thrown into sulphuric acid the liquid immediately surrounding this crystal will assume a deep brown tint, if nitric acid is present. This tint generally vanishes on agitating the liquid, and always after the application of heat for some time.

For delicate experiments, and for certain uses in the arts, particularly the preparation of Saxon blue, the sulphuric acid must be carefully freed from nitrous and nitric acids.

Presence of Water.—If sulphuric acid is exposed to the air, it rapidly absorbs moisture and increases in bulk at the same time. In a damp atmosphere three volumes of the concentrated acid increase to four volumes in the course of twenty-four hours, and a much larger quantity of water may be acquired by a longer exposure.

The real strength of sulphuric acid is best judged of by saturating a known quantity with an alkali, and it may be assumed as sufficiently correct, that 100 grains of dry carbonate of soda neutralize 92 parts of pure liquid sulphuric acid; or that 100 grains of acid require 108 or 108.5 grains of carbonate of soda for saturation. Its specific gravity is also a good test of its value, and tables have been con-

structed showing the quantity of real acid contained in the diluted acid of various densities. Thus—

Acid of sp. gr. 1.845 contains one part real acid and one part water.

Acid of sp. gr. 1.780 ————— one ————— two parts water.

Acid of sp. gr. 1.632 ————— one ————— three parts water.

SULPHURIC ETHER.

Æther Sulphuricus, U. S.

A transparent, limpid liquid, of a hot pungent taste and fragrant odour. Its specific gravity in its purest form is from 0.716 to 0.730, but the ether of the shops is seldom less, and often more than 0.750, owing to the presence of alcohol. It is very volatile, a few drops poured on the hand instantly evaporating with the production of cold: it boils at about 98° . It should burn with a brighter flame than alcohol, give but little smoke, and leave no residue.

By exposure to air and light, as in vessels which are frequently opened, ether gradually absorbs oxygen, and thus a portion of acetic acid is generated. The presence of this acid is not at first apparent, because it forms acetic ether, but it gives the ether a peculiar odour, and in time it becomes acid to tests. A more common adulteration is the mixture of a large proportion of alcohol. I have recently examined several specimens put up in bottles and labelled "best sulphuric ether," which did not contain ten per cent. of real ether, and which were wholly worthless for the purposes of the laboratory. When pure ether is shaken with an equal volume of water, its bulk is not diminished more than about one-tenth, but in proportion as it is mixed with alcohol will the bulk of the suspected ether be diminished by this treatment. The method given by the Edinburgh College for detecting and measuring any alcohol which may be contained in ether is to agitate it in a minim measure, with half its volume of a concentrated solution of chloride

of calcium. This will remove the alcohol, and the reduction of the volume of the ether when it rises to the surface will indicate its amount. Heavy oil of wine may be detected by the ether becoming milky upon being mixed with water. Should sulphuric acid be present, from carelessness in the manufacture, when the ether is mixed with water and treated with a solution of chloride of barium, it will cause a white precipitate, insoluble in nitric acid. These impurities may be removed by shaking the ether in a close vessel, with about twice its bulk of water, pouring off the ether, adding to it a sufficient quantity of well burnt lime and distilling the mixture. The first third that distils over is pure ether.

SULPHURIC ETHER, SPIRIT OF.

Spiritus Ætheris Sulphurici, E.

This is a mixture of one measure of sulphuric ether and two measures of rectified spirit. Its density should be about 0.809. When pure, it does not affect litmus paper, or render water turbid. When agitated with twice its volume of a concentrated solution of chloride of calcium twenty-eight per cent. of ether separates by rest. It possesses the advantage over sulphuric ether for medicinal purposes in being miscible with water in all proportions.—(*Pereira's Materia Medica.*)

TALLOW.

This is the concrete fat of oxen, deer and large quadrupeds, in general, melted and separated from the fibrous matter with which it is at first accompanied. It consists chiefly of stearine, with a little olcine, and is firm, brittle, and has a peculiar heavy odour. It soon becomes rancid on exposure to the air. As met with in commerce, it usu-

ally has a yellow tinge; but when pure, it is white and nearly insipid. It is divided into two principal varieties, according to its purity and consistence, viz., candle and soap tallow; and these are subdivided into other classes, according to the colour of the tallow, and to the place from whence it is obtained. Its quality depends in some degree on the animal from which it is procured; but more probably, on the care observed in its preparation.—(*Parnell's Applied Chemistry.*)

The purity of tallow can, in general, be judged of by its colour and consistence, by its burning with a clear white light, and by its leaving little or no residue when subjected to heat.

TAMARINDS.

Tamarindus, U. S.

The fruit of the *Tamarindus Indica* L., an East Indian tree, and of the *T. Occidentalis* Gært., a native of the West Indies. As imported, they are of a reddish yellow, or reddish brown colour, of the consistence of candied honey, being composed of the pulp, the seeds and numerous vegetable fibres. They have a slightly vinous odour, and an agreeable acid taste. They contain sugar, citric, tartaric and malic acids, to which their refreshing properties are to be ascribed. The oriental tamarinds are more pulpy than the occidental ones. They also have a darker colour, and being preserved without sugar, are more acid and better adapted for medicinal purposes than the West Indian fruit, which is preserved by the addition of a considerable quantity of sugar.

Tamarinds frequently contain an appreciable quantity of copper which is derived from the vessels in which the pulp has been evaporated. The presence of this metal may be

detected by the reddish coloured coat which is formed upon a bright piece of iron when plunged into the tamarinds. Sulphuric acid is also sometimes added to the fruit when it has not been well preserved, or too long kept, to give it an acid taste. This is readily ascertained by the white precipitate, insoluble in nitric acid, which the filtered decoction of tamarinds gives with the chloride of barium.

Tamarinds are sometimes imitated by a mixture of black prunes with tartaric acid, or tartrate of potassa; but this fraud can be detected on account of the absence of the smooth, hard, quadrangular seeds which form part of the genuine fruit.

TAPIOCA.

Tapioca, U. S.

This is obtained from the tubers of the *Jatropha Manihot* L., a native of South America, and is one of the purest forms of starch met with in commerce. It occurs in irregular, hard, granular masses, from its having been dried on hot plates with agitation. It is white, inodorous and tasteless, slightly soluble in cold water, and the solution strikes a blue colour with iodine, which shows the rupture of some of the starch granules in the preparation of this substance. Most of the granules, however, remain uninjured, and when examined by the microscope are found to be spherical, of nearly equal size, and smaller than those of arrow-root, or the average of wheat starch.

A factitious tapioca occurs in the shops, consisting of very small, smooth spherical grains, probably prepared from potatoe starch. It passes under the name of *Pearl Tapioca*, and may be distinguished from the genuine, by the characters of Potatoe starch, given in the article STARCH.

TARTARIC ACID.

Acidum Tartaricum, U. S.

This acid, when pure, occurs in transparent, colourless crystals, the primary form of which is a rhombic prism. But it is often found in the form of a mass resembling the lumps of fine salt. It has a very sour taste, reddens litmus powerfully; is soluble in one and a half parts of cold, and in less of hot, water; also soluble in alcohol. The solution is very sour, and causes with solutions of caustic lime, baryta and strontia, white precipitates soluble in an excess of the acid. If it be added in excess to a concentrated solution of a potassa salt, small granular crystals of bitartrate of potassa are deposited.

Tartaric acid is adulterated with various substances; as, sulphuric acid, malic acid, lime and potassa.

Detection of Sulphuric Acid and Lime.—To a solution of the suspected tartaric acid add chloride of barium; if sulphuric acid is present, a white precipitate will be produced, which is insoluble in nitric acid. If, when neutralized by ammonia, it gives a precipitate with oxalic acid it indicates the presence of lime.

Detection of Malic Acid.—Malic acid causes the tartaric acid to become moist on exposure to the air. It may be detected by the following process: Neutralize a solution of the suspected tartaric acid with ammonia, and then add solution of chloride of calcium. Tartrate of lime will be precipitated while the malate of lime, if any is present, will be held in solution. Filter, and add alcohol to the clear solution; the malate of lime will be thrown down in the form of a white powder. If the tartaric acid contains sulphuric acid, sulphate of lime will be thrown by the same

process. But the two salts can be distinguished by the different effects produced by heat. Malate of lime is fusible into a gummy mass in a boiling solution, and if it is subjected to a higher heat it is decomposed with the usual results of the distillation of a vegetable salt. Sulphate of lime does not suffer decomposition even at a very high temperature.

Detection of Potassa.—If potassa is mixed with tartaric acid, it is probably in the form of the bitartrate. The presence of this salt may be suspected when the tartaric acid does not dissolve in one and a half parts of water, and when the saline residue is rendered entirely soluble by the addition of solution of potassa.

TEA.

This important article is the leaf of an evergreen shrub, the *Thea Chinensis Sims*, a native of China and Japan, and extensively cultivated in both countries, but especially in the former. Linnæus supposed that there were two distinct species from which tea was derived, viz. : *T. Bohea* and *T. viridis*, and this view is adopted by Lindley; but De Candolle and Sprengel consider these merely as varieties. According to Lindley, the leaves of the *T. viridis* are acuminate and emarginate at the apex, while those of the *T. Bohea* are smaller, flatter, darker green, finely serrate and terminating in a point, but not at all acuminate or emarginate.

The numerous varieties of tea which exist in commerce may all be arranged under the two divisions of *green* and *black*. The former of these is characterized by a dark green colour, an aromatic odour, and an astringent, agreeably bitter taste. The latter has a dark brown colour, sometimes inclined to black, a fainter odour and a less pungent taste. The active principle of tea is *Thein*, a white, crystalline sub-

stance, which may be easily obtained, after the separation of the tannic acid and colouring matter, by the process of sublimation. It has been found to be identical with *Caffein*, procured from coffee, and the opinion has been advanced by Liebig and adopted by several other chemists, that it contains essential principles of nutrition which exceed in importance its stimulating properties. If this is correct, tea and coffee are to be ranked, in every respect, among the most desirable articles of general use.

The frauds in tea seem to have kept pace with the increase in its consumption. These consist principally in the substitution of the leaves of other plants for those of the genuine tea plant, and in the employment of various substances to give a desirable colour to inferior qualities of tea.

Substitution of other Leaves.—According to Dr. Burnett, the leaves of the sloe, *Prunus spinosa* L., are dried in England, as a kind of tea, and mixed in large proportion with China tea. From the result of a parliamentary investigation, it appears that upwards of four millions of pounds of factitious tea are, on an average, annually made in that country, and used to mix with that imported from China. An attempt was made to legalize the practice by taking out a patent for the preparation of “British leaf” as a substitute for tea, but it was soon ascertained that this article was not sold at retail and used as such, but was purchased by fraudulent grocers to adulterate the genuine article.—(*Outlines of Botany.*) The manufacture was then suppressed, and subsequently upwards of forty-five hogsheads of leaves, in different stages of preparation, were condemned and burned. There can be no doubt that this adulteration is still largely, although clandestinely, practised.

It appears that the manufacture of factitious tea is extensively carried on by the Chinese themselves. Dr. Royle

states that "the Chinese in the neighborhood of Canton are able to prepare a tea which can be coloured and made up to imitate various qualities of green tea, and large quantities are thus yearly made up." And Dr. Dickson informs us that "the Chinese annually dry many millions of pounds of leaves of different plants, to mingle with the genuine, as those of the ash, plum, &c."—(*Penny Cyclopædia*, art. *Thea*.)

The mixture of other leaves with those of the tea plant may sometimes be detected by the difference in their botanical characters. For the purpose of examination, the leaves should be macerated in water and then spread out and pressed between papers until they are perfectly dry. The leaves of the tea plant are oblong or lanceolate, acutely pointed, serrate, except at the base, smooth on both sides, green and shining, marked with one rib and many transverse veins. The leaves of the sloe are much broader in proportion to their length than those of tea; they have a rounder form, and an obtuse instead of an acute point; their surface, moreover, is more uneven, and their texture less delicate. The spurious leaves employed by the Chinese, are sometimes so cut up as to render it impossible to ascertain the plant to which they belong. In the adulteration of a peculiar kind of tea, called *Ankoi*, the most common are said to have been a thick, soft, dark green, very smooth leaf, and a palish, hairy leaf, with the veins strongly marked. The former can be detected only by inspecting the leaves after infusion, as it imparts no bad smell to the tea, and it is hardly perceptible even to the taste; the latter is readily discovered by its giving to the tea a "faint and odd" smell as well as taste.—(*Davis' "Chinese."*)

Employment of Colouring Materials.—The other class of frauds which are practised with tea, consist in the use of various colouring materials, to give other leaves the appear-

ance of those of the tea plant, and to increase the value of the inferior kinds of tea.

Mr. R. Warrington, after examining a great number of samples, concludes that all the green teas imported into England are faced or covered superficially with a powder consisting of either Prussian blue and sulphate of lime or gypsum, with occasionally a yellow or orange-coloured vegetable substance ; or of sulphate of lime previously stained with Prussian blue ; or of Prussian blue, the orange-coloured substance, with sulphate of lime and a material supposed to be kaolin. These facings or coverings occurred in what are called the *glazed*, while sulphate of lime alone was found in the *unglazed*, varieties. With a little care, he says, "the whole of the powder with which the tea was covered could be easily removed, by simply agitating the samples briskly for a few seconds in a phial with distilled water, and then throwing the whole on a lawn filter, in order to strain the liquid, with the suspended matter, from the leaves as rapidly as possible." The presence of Prussian blue was shown by adding a drop of caustic potassa to a little of the sediment, when the green hue was instantly converted to a bright reddish brown, the original blue appearance being again restored by the subsequent addition of a little sulphuric acid. By subjecting another portion to a red heat, the whole of the vegetable matter and the Prussian blue were destroyed, and a white powder, with a slight shade of brown, obtained. This was dissolved in dilute muriatic acid, and when tested with solution of chloride of barium, gave indications of sulphuric acid ; it was then evaporated to dryness, and again acted upon by very dilute muriatic acid ; a trace of silica remained undissolved. Solution of ammonia being added, threw down a little alumina and oxide of iron, and the ammoniacal solution treated with oxalic acid, gave a precipitate of oxalate of lime. The white powder left after the calcina-

tion of the coloured substance, and boiling the residue in distilled water, was supposed to be kaolin or powdered agalmatolite, the figure stone of the Chinese.—(*Warrington, in Lond. Edin. & Dub. Phil. Mag. &c.* xxiv. 507.)

Mr. Davis, in his interesting work, above quoted, states some facts in regard to the adulteration of tea, which entirely confirm the results of the investigations of Warrington and others. Thus young hyson, until spoiled by the large demand of the Americans, is said to have been a delicate and genuine leaf. But as it could not be fairly produced in any large quantities, the call for it on the part of the Americans was answered by cutting up and sifting other green teas through sieves of a certain size. The coarsest black tea leaves were also cut up and then coloured with a preparation resembling the hue of green teas. “But this was nothing in comparison with the effrontery which the Chinese displayed in carrying on an extensive manufactory of *green teas* from *damaged black leaves*, at a village or suburb called Honan.” In one of these “laboratories of factitious hyson” which Mr. Davis visited, large quantities of black tea which had been damaged in consequence of the floods of the preceding autumn, were drying in baskets with sieve bottoms, placed over pans of charcoal. The dried leaves were afterwards transferred in small portions to cast iron pans and mixed with a small quantity of turmeric in powder which gave the leaves a yellow or orange tinge; they were afterwards stirred with a mixture of Prussian blue and gypsum which had a light blue colour. The coarse leaves were then picked out by hand and the rest passed in succession through sieves of different degrees of fineness. The first sifting produced what was sold as Hyson Skin, and the last by the name of Young Hyson.

Mr. Davis further states it as a well-ascertained and undeniable fact, that the Chinese themselves do not consume

those kinds of green tea which are prepared for exportation. Those which are most esteemed by them are made from the green tea plant, and have a yellower, and as it were a more *natural*, hue than the bluish green that distinguishes the teas which they send away.

Much was formerly said about the employment of some of the salts of copper for the colouring of teas, but this seems to be rarely, if ever, resorted to. Their presence, however, can easily be detected by agitating a small quantity of the suspected tea in water for some minutes and then adding to it a solution of ammonia or of ferrocyanide of potassium. A salt of copper will produce with the former, a fine blue liquid, and with the latter, a reddish brown precipitate.

The presence of logwood, sometimes used for colouring tea, may be ascertained by rubbing the suspected article upon paper, after it has been moistened. A bluish black stain will be produced; and when such adulterated tea is thrown into water, it gives a tint of the same colour, which is reddened by the addition of a few drops of sulphuric acid. Pure tea forms a liquid of an amber colour, which is not reddened by this acid.

It has been stated in an English journal that some of the London tea merchants have introduced a new species of fraud, which consists in obtaining from the large hotels the spent tea leaves, drying and rolling them, under the influence of a gentle heat, by a process similar to that practised in China with the fresh leaves. The leaves thus deprived of their thein, before being mixed with those of genuine tea, are coloured with Prussian blue and other substances to bring them to the tint of the peculiar variety which it is intended to imitate. We are also informed that a quantity of tea, damaged in consequence of the shipwreck of a vessel, was washed in order to remove the sea salt, and afterwards

faced with a powder composed of indigo, chromate of lead, and tale. In this condition the article was exposed for sale, and a considerable quantity of it fell into the hands of the French police.—(*Garnier & Harel.*)

THENARD'S BLUE.

Cobalt Blue.

This is a beautiful blue pigment obtained by the decomposition of nitrate of cobalt by phosphate of soda, and the mixture of the washed precipitate which results, with a certain quantity of alumina. It sometimes has a greenish tint which is owing to the presence of a little phosphuret of cobalt or of oxide of iron.

TIN.

Stannum, U. S.

A well-known metal having a white colour and a lustre resembling silver. It is soft and inelastic, and when bent backwards and forwards emits a peculiar crackling noise. At 442° F. it fuses, and if at the same time it is exposed to the air, its surface tarnishes, and a grey powder is formed. Its specific gravity when pure, is 7.29, but when alloyed with other metals it is usually higher.

Tin is sometimes adulterated with lead, copper, iron and arsenic. Boil the suspected metal in pure nitric acid, until it is entirely converted into the peroxide of tin. Wash this powder with water, filter the solution and test it with sulphuric acid. If lead is present a white precipitate will result. The solution filtered from the sulphate of lead may next be tested for copper and iron, which are also sometimes mixed with tin. Add solution of ammonia to the filtered solution. If copper is present a blue transparent

liquid will be formed, but reddish brown insoluble flocks will indicate the presence of iron. Minute quantities of arsenic have also been occasionally found in specimens of tin. A process for the detection of the former metal, and its separation from the latter, will be found in the article SULPHURIC ACID.

Dr. Ure's mode of testing the quality of tin is as follows: "Dissolve a certain weight of it with heat in muriatic acid; should it contain arsenic, brown black flocks will be separated during the solution, and arseniuretted hydrogen will be disengaged, which, on being burned at a jet, will deposit the usual grey film of metallic arsenic upon a white saucer held a little way above the flame. Other metals present in tin, are to be sought for by treating the above solution with nitric acid of the specific gravity of 1.16, first in the cold, and at last with heat and a small excess of acid. When the action is over, the supernatant liquid is to be decanted off the peroxidized tin, which is to be washed with very dilute nitric acid, and both liquors are to be evaporated to dissipate the acid excess. If on the addition of water to the concentrated liquor, a white powder falls, it is a proof that the tin contains bismuth; if on adding sulphate of ammonia, a white precipitate appears, the tin contains lead; water of ammonia added to supersaturation, will occasion reddish brown flocks, if iron is present; and on evaporating the supernatant liquid to dryness, the copper will be obtained."—(*Dictionary of Arts, &c.*)

The Malacca and the Banca tin and the English grain tin are said to be the purest kinds found in commerce, while block tin and the metal obtained from Germany are usually adulterated.

A preparation called *Powder of Tin*, is sometimes made for pharmaceutical use, by shaking the melted metal in a wooden box rubbed with chalk on the inside; tin filings

have also a place in some pharmacopœias. These preparations, however, are said to be dangerous in consequence of the slight oxidation of the metal.

Pewter filings are sometimes substituted for tin filings in commerce ; and Christison says that lead powder is not unfrequently sold for powder of tin. These adulterations may be detected by acting upon the specimens with nitric acid, and then treating the solution with sulphuric acid as above described.

TIN, BISULPHURET OF.

Aurum Musivum.—Bronze Powder.

This is a compound of a golden yellow colour, consisting of brilliant scales which are very friable and adhere to the fingers. It is insoluble in the acids, except in nitromuriatic acid. When mixed with twice its weight of nitre and heated to redness, it is decomposed with a violent explosion. It is soluble also in a solution of the alkaline sulphurets. In a solution of caustic potassa, with the aid of heat, it dissolves slowly and assumes a greenish colour.

The best bronze powder is brought from Holland and Germany. It should not be confounded with the hydrated bisulphuret of tin, which is obtained by the humid process, and has very different properties. The latter has a pale yellow colour, and when decomposed by heat gives rise to water, sulphurous acid and sulphur, and leaves a residue consisting of bisulphuret of tin, probably mixed with the protosulphuret or the peroxide of that metal. It dissolves easily in solution of potassa, from which it is again precipitated by acids. It is also readily soluble in boiling muriatic acid, with the disengagement of sulphuretted hydrogen.

TITANIC ACID.

When pure, this substance is white, but it acquires a yellowish tint at a high temperature, which it again loses on becoming cold. It seems, however, to give this tint to certain porcellaneous mixtures, as it is used in the manufacture of artificial teeth. After exposure to a red heat it is not attacked by any acid except the hydrofluoric ; but it is rendered soluble by ignition with an alkaline carbonate. Its solution gives a bulky red precipitate with infusion of galls, which is very characteristic. It often contains a small portion of iron which injures its colour.

TURMERIC.

Curcuma, U. S.

The root of the *Curcuma Longa L.*, a native of the East Indies, and cultivated in various parts of Southern Asia. There are two varieties, the *long* and the *round*. The former occurs in short, roundish, somewhat curved pieces, about the thickness of the little finger, reddish yellow externally, reddish brown within ; the latter, more rare, is round, oval, or ovate, about two inches long, and marked externally with numerous annular wrinkles. The taste of turmeric is warm and somewhat aromatic. It tinges the saliva yellow, and gives an orange yellow powder. The colouring principle, which has been named *Curcumin*, may be obtained by digesting the alcoholic extract of the root in ether.

Turmeric is one of the ingredients of *Curry powder*, and is used as a yellow dye. It is also employed in chemistry as a test for the alkalies and alkaline earths, which change its fine yellow colour to a red brown. By this means turmeric can be distinguished from other roots which it resembles.

TURNBULL'S BLUE—*See* PRUSSIAN BLUE.

ULTRAMARINE.

The real ultramarine is a beautiful blue pigment obtained from the *Lapis Lazuli*, a mineral found in Persia, China, Siberia, and Bucharía. It works well with oil, and does not change by time. It is now made artificially, and the manufactured ultramarine is little, if at all, inferior to that obtained from the native mineral.

The high price of this article has led to its adulteration. The genuine ultramarine, when subjected to a high heat, fuses into a white, transparent, or opaque glass. With nitric and muriatic acids it forms a jelly, with the evolution of sulphuretted hydrogen. When diffused through water the colour of ultramarine is discharged by a current of gaseous chlorine. No substance which can be mixed with, or substituted for, the true ultramarine, exhibits these properties.

UVA-URSI.

Uva-Ursi, U. S.—*Bearberry*.

The leaves of the *Arctostaphylos Uva-ursi* Sprengel, a native of the Northern parts of Europe, Asia, and America. As they occur for medicinal use, they are dark green, shining, convex above, concave and reticulated on the under surface; they have an astringent, somewhat bitter taste, and when powdered they give out an odour something like that of hay.

The leaves of the red whortleberry, *Vaccinium Vitis-idaea* L., and of the common box, *Buxus sempervirens* L., are often mixed with, or substituted for, those of the uva-ursi. The former are readily distinguished by their being dotted on the under surface, and minutely toothed at the edges; the latter are detected by their want of astringency.

VENICE TURPENTINE.

This is obtained from the *Larix Europæa* D. C., by openings in the trunks of the trees. It is a thick and consistent fluid, flowing with difficulty, usually cloudy, but sometimes transparent, having a yellow or greenish-yellow colour, a peculiar odour, and an acrid bitter taste. It is distinguished from common turpentine by its having little or no tendency to concrete.

Venice turpentine is said to be no longer imported into England or this country. A factitious article, which has taken its place, and is known by its name, is prepared by mixing oil of turpentine with black rosin.

VERATRINE.

Veratria, U. S.

A vegeto-alkali obtained from the seeds of the *Veratrum Sabadilla* Retz., and the roots of *Veratrum album* L., or white hellebore; and from the *Colchicum autumnale* L., or meadow saffron. In a state of purity it is white, incrustalizable, friable, inodorous, of a very acrid taste, but without bitterness. It is nearly insoluble in water, but is soluble in alcohol and ether. When treated with strong sulphuric acid, it assumes an intense red colour, and with nitric acid it forms a yellow solution. A minute quantity of it excites violent sneezing, and a few grains produce death.

In its impure form, veratrine has the appearance of a resin. As it occurs in commerce it often contains a considerable proportion of lime, or magnesia, sometimes employed in its manufacture; and as they improve the appearance of the alkali and prevent it from becoming resinous by drying, they are purposely left in admixture. This may be ascertained by heating a portion of the veratrine in a platinum

spoon. If it is pure it will all sublime ; lime or magnesia will be left behind, if mixed with the veratrine. To purify veratrine from these substances, dissolve it in alcohol, adding a small quantity of sulphuric acid, filter, precipitate with ammonia, and distill over the alcohol.

WATER.

The purest water that can be found, as a natural product, is produced by freshly fallen snow, or by receiving rain in clean vessels at a distance from houses. But this water is not absolutely pure, for it contains a portion of air or gas, as can be proved by placing a tumbler of it under the receiver of the air-pump, and exhausting the air.

Water that has once fallen on the ground, becomes impregnated with a greater or less proportion of saline and earthy matters. The presence of these substances interfere greatly with the purity of the water, as can be proved by its not dissolving soap. A few tests will, in general, determine the nature of the impurities found in water. Thus, solution of chloride of barium will cause a white precipitate if carbonic or sulphuric acid is present. Should the precipitate be insoluble in muriatic acid, it indicates the presence of sulphuric acid. If a white precipitate results from the addition of a solution of nitrate of silver, it is due to chlorine ; and if oxalate of ammonia causes a white precipitate, it is owing to lime. A small fragment of a gall-nut, suspended in the water, will, after twelve or twenty-four hours, be surrounded with a bluish cloud, if only the smallest proportion of iron is present.

The purification of water, for the purposes of analysis and pharmacy, can be effected by the process of distillation, which consists in subjecting the water to heat in a retort, to which a receiver is attached ; the latter being kept cold by ice or snow, or by being immersed in cold water. The first

portions are to be rejected, as they may contain some gaseous matter, and the process must be stopped when about three-fourths of the water are carried over. The distilled water thus obtained, should be kept in clean and well-stopped bottles.

WAX.

Cera Flava and *Cera Alba*, U. S.

In its common form, wax has a bright, pale yellow colour ; is insipid to the taste, with a slight odour of honey. It is solid at ordinary temperatures, and somewhat brittle and granular, but may easily be cut with a knife and moulded between the fingers. It is insoluble in water, cold alcohol and ether ; but when assisted by heat is soluble in the fixed oils, forming a compound of variable consistence, which is the basis of cerates and ointments. When wax is prepared it is melted at a gentle heat, with a small quantity of water, and then poured into moulds to give it a certain form. As the wax cools, it deposits a variety of impurities, which are cut from the bottom of the cake with a knife. In purchasing wax, the cake should be broken, in order to ascertain whether these impurities have been removed.

The substances generally employed to adulterate wax, are, resin, tallow, earth, pea meal, potato starch and a mixture of oil and litharge. Earth and pea meal may be suspected when the cake is very brittle and the colour inclines more to grey than to bright pale yellow ; these substances may be separated by re-melting and straining the wax. The presence of resin may be suspected when the fracture appears smooth and shining, instead of being granular ; and it may be detected by putting small pieces of the wax into cold alcohol, which will readily dissolve the resinous part, but will not act on the wax. Tallow is discovered by the greater softness and unctuousity of the cake, and by the disagreeable

suffocating odour which it exhales on being melted. Potatoe starch is detected by digesting the suspected wax in spirit of turpentine, at a gentle heat. The wax dissolves entirely in this liquid, but the starch remains behind. Wax which contains starch has generally a dull yellow colour, and is much heavier than wax of a good quality.

White wax is sometimes adulterated with carbonate of lead, white tallow and spermaceti. The presence of the former may be ascertained by melting the wax in water, when the salt falls to the bottom of the vessel; or by moistening the adulterated wax with liquid sulphuretted hydrogen, which turns it black. Tallow is detected by the dull white colour, and the opacity which it communicates to the wax. The mixture of spermaceti and white wax is softer and more opaque than pure wax, and the surface of the cake exhibits a peculiar mottled appearance. It is also more easily fusible than pure wax.—(*Domestic Chemist.*)

WHEAT FLOUR.

This well-known substance is the flour of the seeds of the *Triticum vulgare* Vill., of which there are several varieties extensively cultivated in various parts of the world. It is white, inodorous, and nearly insipid. Its chief constituents are starch, saccharine matter, gum, and a nitrogenous principle, commonly called gluten, but which has been ascertained to be a compound of vegetable fibrin and albumen. It is now generally admitted that the nutritive properties of wheat flour depend chiefly upon the gluten, and hence the value of different samples may be determined by ascertaining the proportion of this substance which they contain.

The adulterations of wheat flour and of the bread manufactured from it, consist in the mixture of cheaper and less nutritious substances, as rye and bean flour, potatoe starch, &c.; and in the addition of various saline bodies to facilitate

the process of manufacture, and to enable the baker to use inferior, and even damaged, kinds.

Proportion of Gluten in Wheat Flour.—As the nutritive powers of sound flour and also of bread, are proportional to the quantity of gluten which they contain, it is of great importance to determine this point. For this purpose various processes have been proposed. One of these consists in digesting in a water-bath, at the temperature of 167° F., 1,000 grains of flour (or bread), with 1,000 grains of bruised barley-malt, in 5,000 grains, or in a little more than half a pint, of water. When this mixture ceases to take a blue colour from iodine, (that is, when all the starch is converted into soluble dextrine,) the gluten left unchanged may be collected on a filter cloth, washed, dried at a heat of 212° F., and weighed. The colour, texture, and taste of the gluten ought also to be examined, in forming a judgment of good flour or bread.—(*Ure's Dictionary of Arts, &c. Suppl.*)

Another test for ascertaining the proportion of gluten in a given quantity of flour, has been proposed by M. Boland, and is as follows: Weigh exactly 1,000 grains of the flour to be examined and put it into a capsule. Into a cup formed of the flour pour about 400 grains of water, stir with a spoon or spatula, until the whole of the water is absorbed and a plastic and consistent mass obtained. It is then kneaded between the fingers for two or three minutes, and afterward left for fifteen minutes in summer, and about an hour in winter, that the hydration may be completed. A metallic sieve is then immersed in cold water and the paste is plunged repeatedly, for an instant at a time, into the water of the sieve, constantly kneading it, slowly at first, and afterwards more rapidly. By a little practice, the water, the greater part of the starch, and the soluble matters may be removed, while the adhering particles of gluten remain in the hand in the form of an elastic

mass. The sieve is then raised, and any shreds of gluten which may have escaped are united to the mass. The washing of the whole is completed by kneading it strongly for ten minutes under a stream of cold water. The gluten thus obtained is subjected to strong pressure, then wiped dry and weighed; it is afterwards put into an oven, where it is quickly dried, and before it changes colour is taken out and weighed a second time. We thus determine the proportions of moist and dry gluten which serve as a check upon each other. By this test the addition of from ten to fifteen per cent. of starch can be determined, as it reduces in the same ratio the proportion of gluten.

In following out these processes it should be recollected that the proportion of gluten depends as much upon the state of humidity or dryness of the flour, as upon its quality. Thus, although the best samples of flour contain from eleven to seventeen per cent. of dry gluten, the amount of water may be so large as even in these to reduce the proportion of the nutritive constituents to that of the inferior kinds. The proportion of water in flour varies from six to twenty-five per cent.; a range which must greatly influence the results of the tests for gluten.

The effect of moisture upon flour is very injurious. It occasions an alteration of the gluten which renders it unfit to produce good bread, and it favours the formation of sporules of different kinds of mushrooms which are afterwards developed in the bread. Dumas states that the flour of the wheat of 1841 suffered great injury in this way during the summer of 1842.

In spoiled flour, such as is said to be often used by the English bakers, and probably also by those of the United States, the gluten disappears altogether, and is replaced by ammoniacal salts. In this case quicklime separates ammonia from the flour without heat; in flour slightly damaged, or ground from damaged wheat, the gluten pre-

sent is deprived of its elasticity, and is softer than in the natural state. On this account the gluten test of M. Boland is valuable. It consists in putting some gluten into the bottom of a copper tube, and in subjecting this tube in an oven, or in oil, to the temperature of 284° F. The length to which the cylinder of gluten expands is proportional to, and indicates, its quality. For details, see *Dumas, Chimie Appliquée aux Arts*, vi. 425.

Detection of Potatoe Starch.—This is said to be a common adulterant of flour and bread in France, although it is seldom employed in England or the United States. When introduced after grinding the flour, the presence of potatoe starch can usually be detected by the microscope, on account of the peculiar ovoid shape and large size of its particles. The proportion of this adulterant cannot be very accurately determined. The process of M. Boland, which is an improvement upon that of Gay Lussac, affords only an approximation to a correct result, (see *Dumas*.) The test of the proportion of gluten, above described, will serve as an indirect method of determining the amount of starch that may have been mixed with the flour.

Detection of Sulphate of Copper.—In Belgium and the northern part of France this substance has been, singularly enough, long used in the manufacture of bread. The bakers are said to derive many advantages from its employment. It enables them to use flour of an inferior quality, and to increase the weight of the bread by the addition of a larger quantity of water. It also lightens the labour of preparing the bread and renders the process of panification more speedy.

The proportion of the sulphate of copper thus employed is sometimes very small, being not more than two or three grains to a loaf weighing about two pounds and a half. But

M. Kulmann has justly observed, that there can be no safety whatever to the public when such a practice is permitted, because ignorance and avarice are always apt to increase the quantity of the poisonous substance. In analyses made by him and his colleagues, portions of bread were several times found so impregnated with this salt that they had acquired a blue colour, and presented occasionally even small crystals of the sulphate.

The presence of sulphate of copper may often be detected by acting on the poisoned bread with distilled water and testing the water with the solution of ferrocyanide of potassium, when the reddish brown precipitate characteristic of copper will appear even if the quantity is quite small. Should the proportion of the sulphate be still more minute, it may be detected by the following process: Incinerate in a porcelain capsule about half a pound of the suspected bread, reduce the product of the incineration to a very fine powder and treat it with two or three drachms of nitric acid. The mixture is subjected to heat until nearly the whole of the free acid is evaporated, and the residue boiled in two or three ounces of distilled water. The whole is then thrown upon a filter, and to the filtered liquor there are added a small excess of solution of ammonia, and some drops of a solution of subcarbonate of ammonia. After being allowed to cool, the copious precipitate which is formed is separated by a filter, and the alkaline liquor is boiled to expel the excess of ammonia, and is reduced to about a fourth of its volume. This liquor, being slightly acidulated by a few drops of nitric acid, is divided into two portions; to the one is added ferrocyanide of potassium, and to the other, sulphuretted hydrogen, or hydrosulphuret of ammonia. If the least portion of sulphate of copper is present, it is rendered evident by the formation, after some hours, of a reddish precipitate with the first test, and of a less voluminous

brown precipitate with the last. It is said that so small a proportion of sulphate of copper as one to 70,000 parts of bread can be detected by this process.

According to Dumas, a few drops of a solution of ferrocyanide of potassium thrown upon bread, produce a rose colour at the end of a few minutes, when there is present only one part of sulphate of copper to 9,000 parts of bread.

Detection of Alum.—The employment of this salt in the fabrication of bread, appears to have been practised from a remote period. It increases the whiteness of bread, and enables the bakers to use inferior kinds of flour. The quantity employed varies greatly, being from one in 964 to one in 127 parts of flour, or from one in 1,077 to one in 143 parts of bread.

The presence of this salt may be detected as follows: Incinerate about half a pound of the bread, treat the residue with nitric acid, evaporate the mixture to dryness, and add distilled water, as in the process for detecting sulphate of copper. Filter, divide the clear liquor into two portions, and to the one add solution of chloride of barium, and to the other a few drops of solution of ammonia. If alum is present, the former will give a dense white precipitate, and the latter a light precipitate, which is redissolved by a small quantity of caustic potassa.

Alkaline Carbonates.—Several authors have asserted that carbonate of ammonia may be advantageously employed for making bread light and increasing its whiteness. The property which this salt has of being converted into vapour and even of being decomposed into carbonic acid and ammonia by the action of heat, seems to justify this assertion.

The carbonates of potassa and soda seem also to have been used, probably for the purpose of preserving for a longer time the moisture of the bread, or of increasing its lightness by the disengagement of carbonic acid.

Numerous other substances have sometimes been mixed with flour to increase the whiteness and weight of the bread, such as chalk, pipe-clay and plaster of Paris. As they answer no purpose unless they are added in considerable quantity, their presence can in general be determined by the incineration of the bread and by the comparison of the weight of the residue with that obtained from the same quantity of unadulterated bread. If nitric acid be added, chalk may be detected by its effervescence, while the plaster will be dissolved. The calcareous matter may be rendered evident in the solution by neutralization with ammonia, and the subsequent addition of oxalic acid.

WINE.

Vinum, U. S.

Wine is a transparent liquid, of a yellowish, reddish yellow, or deep red colour. It consists principally of water and alcohol; but a great number of other substances are also found in it, as, sugar, fecula, gluten, extractive, colouring matter, tannic acid, bitartrate of potassa, tartrate of lime, volatile oil, ænanthic ether, &c. It is upon the volatile oil that the peculiar taste and odour of wine, called the *bouquet*, is supposed to depend. The proportions of the ingredients vary greatly in the different kinds of wine. Tannic acid and colouring matter are in larger quantity in the red wines than in the white, while the alcohol ranges from nine or ten to twenty-five per cent.

Numerous frauds are practised with wine, and it is to be regretted that chemistry does not yet furnish the means of detecting them all with certainty. The most common of these are the mixture of wines of different vintages, and the addition of water, of brandy, of colouring matters, and of various saline substances.

Colouring Matters.—The colour of red wines is due to the skins of the red raisins, with which the *must* is fermented. These wines also derive from this source the tannic acid to which they owe their astringent taste and their change from a red to a brownish black colour, upon the addition of a soluble persalt of iron.

Among the substances said to be used for the purpose of giving a red colour to wines, are logwood, Brazil-wood, beet root, and the fruit of the elder and of the sloe. The process most to be relied on for determining their presence is that of Nees d'Esenbeck. It consists in dissolving one part of alum in eleven parts of distilled water, and one part of carbonate of potassa in eight parts of water. The suspected wine is mixed with an equal volume of the solution of alum, which renders its colour more brilliant; to this mixture the alkaline solution is then added, little by little, taking care not to decompose all the alum. The alumina is precipitated with the colouring matter of the wine in the form of a lake, which, both before and after the addition of the potassa, assumes tints which vary with the nature of the colouring matter. In pure wine the solution of alum produces a lake of a dirty grey colour, which an excess of the alkali partly dissolves, leaving the residue of an ash grey colour. If the wine has been coloured by any of the substances above mentioned, the precipitate left, after following out this process, is some shade of blue, violet, or rose.

Detection of Carbonates.—The carbonates of lime, potassa and soda are sometimes employed to neutralize the acidity of certain wines. The first of these may be detected by evaporating a portion of the wine to about one-eighth its volume and adding to the residue twice its volume of alcohol of sp. gr. 0.921. By this means the sulphate and tartrate of lime, which naturally exist in the wine, are precipitated, and the acetate of lime dissolved. The solution is

then filtered, and carefully evaporated to dryness. The filtered solution of this residue in water gives an abundant white precipitate with oxalate of ammonia, and evolves the odour of vinegar when decomposed by sulphuric acid.

Carbonate of potassa is sometimes added to wine for the purpose of stopping the fermentation and of saturating the acetic acid which it may contain in excess. In this case acetate of potassa will exist in the wine. To determine the presence of this salt, evaporate a portion of the wine to a syrupy consistence and agitate the residue for some minutes with a small quantity of alcohol of the sp. gr. of about 0.842; upon the application of heat the acetate of potassa will be dissolved. The liquid after filtration is divided into two parts: the one is treated with a solution of the chloride of platinum, which gives with potassa a yellowish precipitate; the other is evaporated to dryness and the residue moistened with strong sulphuric acid, which liberates acetic acid, known by its peculiar odour. It should be stated that pure wine always contains acetate of potassa, but the quantity is so minute that these tests produce with it scarcely perceptible results.

When wine is saturated with carbonate of soda, the tests employed for acetate of potassa give only negative results. In this case, the residue of the evaporation should be treated with alcohol of the sp. gr. of 0.920, which dissolves the acetate of soda. This solution is then evaporated, the residue dissolved in water, the solution filtered and slowly evaporated. If acetate of soda is present, crystals will be formed which have a sharp and slightly bitter taste, and are decomposed by strong sulphuric acid.

Detection of Lead.—The addition of white lead or litharge to sour wines, to neutralize their acidity and to render them sweet, was formerly often practised, but is now rarely resorted to. The presence of lead in wine may be

detected as follows : Evaporate a portion of the suspected liquor to dryness in a Berlin ware capsule, collect the dry residue and heat it to redness. Triturate the coaly mass with twice its weight of nitrate of potassa, and throw the mixture, a little at a time, into a small porcelain crucible heated to redness. The nitrate of potassa causes the combustion of the charcoal, and a fused mass, which contains the lead, remains. If the matter retains a deep brown colour, the ignition may be repeated with another portion of the nitrate. The residue is then treated with water acidulated with nitric acid until it is completely dissolved. This solution is then filtered, and if it contains a salt of lead it will give a white precipitate on the addition of a few drops of sulphuric acid ; a yellow precipitate with solution of chromate of potassa ; and a black precipitate with sulphuretted hydrogen or hydrosulphuret of ammonia.

Detection of Alum.—Alum is sometimes added to wine for the purpose of heightening its colour and of giving it an astringent taste. If the wine is red, mix it with a sufficient quantity of animal charcoal previously well washed with muriatic acid. When it has been deprived of its colour, filter, evaporate the filtered liquor to one-third of its volume, and then filter it a second time to remove the coloured precipitate which has been formed during the evaporation. If alum is present, the solution will have an astringent taste, and will give, upon the addition of potassa, a white precipitate soluble in an excess of the alkali ; it will also cause, with chloride of barium, a dense white precipitate, insoluble in nitric acid.

Detection of Brandy.—The addition of brandy to poor wines is often practised for the purpose of giving them the more strength to resist decomposition. If the proportion of brandy is large, and the mixture recent, its presence can sometimes be detected by its deflagration when thrown into

the fire ; but when the mixture is of long standing, this test is of no use. The proportion of alcohol in wine can be determined by distillation, but we have no means of distinguishing that which belongs naturally to the wine from that which has been added as an adulterant.

ZINC.

Zincum, U. S.

This metal has a bluish white colour, a laminated texture, and a crystalline fracture. It is quite hard, being with difficulty acted on by a file. When perfectly pure, it may be reduced to thin leaves at ordinary temperatures, but as it commonly occurs, it requires a heat of between 212° and 300° to render it laminable. Its specific gravity is about 7.00. It melts at 773° F. At a red heat it boils, and in close vessels may be distilled, but in open ones burns with a white flame, and forms a flocculent oxide, commonly called *Flowers of Zinc*.

The zinc of commerce, sometimes known by the name of *Spelter*, contains several impurities ; as iron, lead, cadmium, copper, arsenic, and carbon.

Detection of Arsenic.—Dissolve the suspected metal in dilute sulphuric acid. If it contains arsenic, arseniuretted hydrogen will be evolved, which, when burned as it issues from a jet, will cause a grey metallic film upon a porcelain plate held over the flame. This gas also, if passed through a long glass tube heated to redness in the middle, deposits a circular metallic mirror, which by heat is converted into arsenious acid. The latter substance may be dissolved in hot water and again tested by sulphuretted hydrogen and other reagents.

Detection of Cadmium.—Add a large quantity of water to

the acid solution as above obtained, and pass through the liquid a slow current of sulphuretted hydrogen. If cadmium is present, a yellow precipitate will be produced which is insoluble in alkalies or alkaline sulphurets.

Detection of Lead, Copper, Tin, and Iron.—Dissolve the suspected metal in nitric acid, somewhat diluted with water. If any tin is present it will be converted into an insoluble peroxide and may be separated by filtration. The carbon will also remain unacted on. To the filtered solution, add a few drops of dilute sulphuric acid. If it contains lead, an insoluble sulphate of lead will thus be formed, which, when separated by filtration and moistened by a solution of sulphuretted hydrogen, becomes black. To the solution which remains after the separation of the sulphate of lead, add ammonia in large excess. The oxide of zinc will be dissolved. Oxide of copper, if present, will also be dissolved by the ammonia, but in that case the solution will assume a fine blue colour. Oxide of iron, if mixed with the zinc, will appear as a reddish brown flocculent precipitate, insoluble in the alkali.

ZINC, ACETATE OF.

Zinci Acetas, U. S.

When carefully crystallized, this salt occurs in colourless, transparent, hexagonal plates, which effloresce in dry air. As found in the shops it is in the form of opaque, white micaceous scales. It has an astringent and disagreeable taste, is very soluble in water, and moderately so in alcohol. When treated with sulphuric acid it exhales the odour of acetic acid. Its solution gives a white precipitate with sulphuretted hydrogen.

The precipitate thrown down by ammonia from the solution of the pure salt is entirely redissolved by an excess of the precipitant. If oxide of copper is present, the liquid

becomes blue ; if oxide of iron, reddish brown flocks remain undissolved.

ZINC, CARBONATE OF.

Zinci Carbonas, U. S.—*Calamine*.

This substance, sometimes known also by the name *Lapis Calaminaris*, is one of the ores of zinc. It is obtained artificially by the addition of an alkaline carbonate to a solution of sulphate of zinc, or by passing carbonic acid through water containing diffused hydrated oxide of zinc. When pure, it is white, and entirely soluble in sulphuric acid ; but as it ordinarily occurs, it has a pale reddish yellow colour.

Calamine is liable to great adulteration, and it is even said that the article sold under this name in London and Glasgow is nothing more than sulphate of baryta coloured with Armenian bole.—(*The Chemist*, Nov., 1844.) This fraud can be detected by the want of solubility of the suspected substance in sulphuric acid. It is also frequently adulterated with oxide of iron. This substance may be detected by dissolving the calamine in sulphuric acid, and adding ammonia in excess to the clear filtered solution. A reddish brown precipitate will remain, if oxide of iron is present.

When carbonate of zinc is obtained by precipitation from the sulphate by a carbonated alkali, it often contains a portion of the hydrated oxide and of the sulphate of the alkali employed. The latter may be separated by solution in water.

ZINC, CHLORIDE OF.

Zinci Chloridum, U. S.—*Butter of Zinc*.

This is a whitish semi-transparent substance, having the consistence of wax. It is entirely soluble in water, alcohol and ether. When exposed to heat it melts and then sub-

limes. When pure its solution gives white precipitates with ferrocyanide of potassium and hydrosulphuret of ammonia. If iron is present, the former reagent will give a bluish precipitate; and if lead, the latter, a black one.

ZINC, OXIDE OF.

7

Zinci Oxidum, U. S.—*Flowers of Zinc*.

This is an inodorous, tasteless powder, which is perfectly white at common temperatures; but when heated to low redness it assumes a yellow colour, which however gradually disappears on cooling. When heated with charcoal it is easily reduced. It is insoluble in water, but is readily soluble in most acids and in alkalies.

The commercial oxide of zinc is sometimes adulterated with starch, chalk, carbonate of zinc, carbonate of magnesia, or alumina. Starch may be detected by adding tincture of iodine to the solution of the suspected oxide in water. Acetic acid dissolves oxide of zinc but leaves the alumina, if any is present. If effervescence is caused by the addition of dilute sulphuric acid, the sample contains a carbonate. If a residue is left after the action of this acid we may infer the presence of white lead or chalk. The sulphate of lead turns black when moistened with solution of sulphuretted hydrogen, but sulphate of lime continues white. If oxide of zinc contains arsenious acid or oxide of cadmium, its solution in muriatic acid, largely diluted with water, will give a yellow precipitate when treated with sulphuretted hydrogen. Sulphuret of arsenic is soluble in an excess of ammonia, but sulphuret of cadmium is not. The presence of oxides of iron and copper may be detected by processes similar to those described in the article ZINC.

Oxide of zinc, as obtained by combustion, generally contains small particles of the metal, which render it gritty and require to be separated by washing. For pharmaceutical

use, it is best prepared by adding ammonia to a solution of the sulphate of zinc, and washing and drying the precipitate.

The impure oxide of zinc, known in commerce by the name of *Tutty*, often has a bluish cast, from the presence of small particles of metallic zinc. Sometimes a spurious substance is sold for tutty, which is a mixture of blue clay and copper filings made into a paste with water and dried on an iron rod. It is distinguished from the genuine article by its diffusing in water and exhaling an earthy smell, and by its greater friability.—(*U. S. Dispensatory.*)

ZINC, SULPHATE OF.

Zinci Sulphas, U. S.

When pure, this salt is in the form of transparent, colourless, flattened four-sided prisms. It has a bitter and styptic taste, and dissolves in two and a half parts of cold, and in less of boiling, water. When ammonia is added to its solution, a white precipitate is produced, which, if the salt is pure, is entirely dissolved by an excess of the precipitant.

This salt usually occurs in commerce in masses, like loaf sugar, which are formed by heating the rough crystals obtained by the action of sulphuric acid upon zinc until they undergo watery fusion and then pouring them into conical moulds where they solidify. In this state it is almost always contaminated with oxide of iron, and sometimes with the oxides or sulphates of copper and lead. Dissolve the suspected salt in water; sulphate of lead will remain as a white powder, which becomes black when moistened with a solution of sulphuretted hydrogen. To the solution add ammonia in excess; the oxide of zinc at first formed, will be wholly dissolved. If any copper is present, the solution will become blue; while oxide of iron will appear as a red brown precipitate.

ADDITIONS.

(Page 39.)—ARSENIOUS ACID.

M. Wiggers has found oxide of antimony in many samples of arsenious acid. The presence of this oxide may be detected by largely diluting with water the solution of the suspected arsenious acid in muriatic acid, when it is precipitated as a white powder, and by the orange red precipitate caused by treating the solution with a small quantity of sulphuretted hydrogen.—(*Berzelius' Rapport Annuel*, 1844.)

(Page 99.)—IODINE.

Millon has ascertained that iodine, although sufficiently pure to be completely soluble in alcohol, and to sublime without residue, may still be adulterated with iodide of iron. This iodide is partially soluble by being boiled in dilute nitric or muriatic acid, and the presence of iron in the solution may be detected in the usual way. Perfectly pure iodine may be obtained by the decomposition of iodide of potassium by chlorine.

(Page 143.)—MURIATIC ACID.

According to MM. Fordos and Gélis, the best method of detecting sulphurous acid in muriatic acid, is to dissolve a small quantity of zinc in the acid and to cause the evolved hydrogen to pass into a solution of subacetate of lead (or a solution of oxide of lead in caustic potassa); the sulphurous acid is decomposed with the water, and the hydrogen is

mixed with sulphuretted hydrogen, which precipitates sulphuret of lead in the solution. This process gives a sensible reaction with the minutest traces of sulphurous acid, while that with protochloride of tin requires a much more considerable quantity.

OILS, FAT OR FIXED.

M. Heidenreich has pointed out some methods for ascertaining whether the fat oils of commerce are adulterated with cheaper ones. One of these consists in heating a small quantity of the oil in a watch glass, when the peculiar odour enables us to judge in some measure of its purity.

Another test is to put ten or twenty drops of the oil in a watch glass, to let fall on the middle of them a drop of concentrated sulphuric acid, and then to notice for fifteen minutes the changes of colour which are produced.

With *whale* and *cod oil*, a red colour is formed, increasing gradually in intensity; after some time it becomes violet on the edges.

Olive oil, pale yellow passing into yellowish green.

Oil of poppies and *sweet almonds*, canary yellow, passing into an opaque yellow.

Linseed oil, a brown magna, becoming black.

Tallow oil, or *oleine*, a brown colour.

In testing oils, a sample of the oil supposed to be present should be placed alongside of the oil under examination, and both be compared in their reactions with the acid.

The specific gravity of the oil at a given temperature is also proposed as a test of these oils. The following are some of the results of M. Heidenreich:—

| | Sp. gr |
|-----------------------|--------|
| Tallow Oil, or Oleine | 0.9003 |
| Rape Oil | 0.9136 |
| Olive Oil | 0.9176 |
| Purified Whale Oil | 0.9231 |
| Oil of Poppies | 0.9243 |
| Linseed Oil | 0.9347 |
| Castor Oil | 0.9611 |

An instrument has been contrived for determining the specific gravity of oils, called an *Oleometer*. It is nothing more than a hydrometer with a very slender stem. The mode adopted by M. Laurot, a Parisian chemist, is to plunge the oleometer into a tin cylinder filled with the oil, and placed in another cylinder containing boiling water. His instrument is so graduated as to sink to zero in pure colza oil so heated, and he finds that it stops at 210° in linsced oil, at 124° in poppy-seed oil, at 83° in fish oil, and at 136° in hemp-seed oil, all of the same temperature. By the increase of density, therefore, or the ascent of the stem of the hydrometer in any kind of colza oil, he can infer its degree of adulteration.

Dr. Ure recommends the employment of a specific gravity bottle, with a capillary tube stopper, on the above principle. The vessel should be filled with oil, and exposed to the heat of boiling water, or steam at 212° , till it acquires that temperature, and then weighed. The vessel with the pure colza oil will weigh several grains less than with the other oils similarly treated. Such an instrument would serve to detect the smallest adulterations of sperm oil. Its specific gravity at 60° , when pure, is only 0.875; that of southern whale oil is 0.922, or 0.925; and hence their mixture will give a specific gravity intermediate, according to the proportions in the mixture. Dr. Ure states that he has been thus enabled to detect sperm oil in pretended lard oil, in his examination of oils for the Customs.—(*Dictionary of Arts, &c. Suppl.*)

(Page 157.)—OPIUM.

The following method of detecting the presence of opium in a medicine has been proposed by Merck: First add to the mixture a little potassa, and then some ether, agitating it briskly after each addition. When the ether has sepa-

rated, dip into it a piece of paper, let it dry, and repeat the operation several times. Moisten the paper thus prepared with a little muriatic acid, and then expose it to the vapour of boiling water; it assumes a red colour, more or less deep according to the quantity of opium contained in the mixture. This reaction is said to be due not to morphine, but to another base, called porphyroxine.—(*Berzelius' Rep. Ann.* 1845.)

(*Page 178.*)—POTASSIUM, CYANIDE OF.

This article, as employed in the arts, contains many impurities: these are chiefly, cyanate, carbonate and sulphate of potassa, silica, cyanide and ferrocyanide of potassium. The average amount of these impurities is 35 per cent., but it is often as high as 50 per cent. It contains much silica when prepared as is usually directed in earthenware crucibles, and when the exact proportions of ferrocyanide of potassium or carbonate of potassa are not employed; when these are not perfectly anhydrous, salts of ammonia are generated, and when commercial carbonate of potassa is used, sulphate of potassa and chloride of potassium. Even when the materials employed are chemically pure and perfectly anhydrous, it contains 20 per cent. of cyanate of potassa. This, according to Liebig, is of little consequence in the ordinary operations of testing, but in analysis and in electro-metallurgy it is of great importance.—(*Glassford and Napier, Mem. Chem. Soc., Lond.* ii. 86.)

The methods which these chemists propose for determining the per centage of cyanide of potassium in any sample, is as follows: Dissolve a given quantity of the sample in distilled water, and then add a solution of nitrate of silver cautiously, until the precipitate formed ceases to be dissolved. This solution is evaporated to dryness, treated with muriatic acid, again evaporated to dryness and fused, to

determine the quantity of silver. The amount of cyanide of potassium may then be known by the following calculation : As 108 is to 132, (two equivalents of cyanide of potassium,) so is the weight of silver obtained multiplied by 4, to the per centage of cyanide of potassium in the sample.

(Page 180.)—POTASSIUM, IODIDE OF.

Some samples of this salt have been found to contain bromide of potassium. For the detection of the latter, M. Personne has given the following process : Dissolve the suspected iodide in a sufficient quantity of cold distilled water, add an excess of sulphate of copper in solution, then treat the mixture with sulphurous acid. As soon as the latter is in excess, the whole of the iodine is precipitated in the state of protiodide of copper. While the bromide remains undecomposed, we separate the iodide of copper by filtration. The remaining liquid is placed in a tube, treated with a little ether and solution of chlorine, and then agitated. If left at rest the ether will rise to the surface bringing with it the whole of the bromine, which tinges it of a reddish yellow colour.—(*The Chemist*, June, 1846.)

According to Muller, nitric acid is a very delicate test for the presence of iodate of potassa when mixed with iodide of potassium. He states that a solution of one part of iodide of potassium in 15,000 parts of water, adulterated with one 60,000th of iodate of potassa, is rendered decidedly yellow upon the addition of nitric acid.

QUINOIDINE. "

The substance known by this name, of which it is said a considerable quantity has accumulated in the process for procuring sulphate of quinine, has recently been shown by Liebig to be quinine in an amorphous state. It bears the same relation to ordinary quinine that uncrystallizable sugar

(barley sugar) bears to crystalline sugar. It may, therefore, when pure, be used in the same cases as quinine.

The commercial samples of quinoidine are often largely adulterated, and of course differ greatly in their value. The following tests of its purity are given by Liebig: Amorphous quinine is completely soluble in dilute sulphuric acid and in alcohol. It is also completely soluble in a solution of sulphate of copper with separation of oxide of copper. And if its solution in dilute acid yields, upon precipitation by means of ammonia, exactly the same amount of precipitate as the weight of the substance originally dissolved in the acid, there can be no doubt of the perfect purity of the sample under examination.—(*The Lancet*, May, 1846.)

APPENDIX.

APPENDIX.

I.—OPERATIONS AND INSTRUMENTS EMPLOYED IN QUALITATIVE ANALYSIS.

THE following are some of the principal operations employed in qualitative investigations.

REDUCTION OF SOLIDS TO POWDER.

When the substance to be operated on occurs in large pieces or in coarse powder, it must first be reduced by mechanical means to as fine a powder as possible. This may in general be effected by the use of a mortar and pestle of wedgewood ware. In some cases, however, an agate mortar is required. Brittle substances may be reduced to a coarse powder by wrapping them in paper and crushing them with a hammer. Some metallic bodies can only be brought to the proper state of division by the employment of a rasp or file.

SOLUTION.

The general meaning of this term is the “combination” of a gaseous, liquid, or solid substance, with a fluid, forming a homogeneous liquid. But in its more restricted and

usual sense it is the perfect union of a solid substance with a liquid. The liquid by means of which the solution is effected is called the *solvent* or *menstruum*. The solution is said to be *chemical*, when this solvent forms a chemical combination with the substance dissolved; and *simple*, when no definite combination takes place. Common salt when dissolved in water is an example of simple solution; while magnesia, when dissolved by sulphuric acid, affords an illustration of chemical solution. A simple solution is said to be *saturated*, when the solvent has received as much as it can hold of the substance to be dissolved. A chemical solution is said to be saturated or *neutralized*, when the opposite properties of the solvent and the body on which it acts are completely lost. In cases where acids and alkalis combine by this kind of solution the neutralization can be determined by the employment of certain tests, as litmus, turmeric, &c.

For performing the operation of solution a few vessels are required, as, Florence flasks, glass and Berlin ware capsules. The latter of these sustain a high heat, and are exceedingly useful in analysis. Glass tumblers may be employed in cases where no heat is required. Glass test tubes of various sizes are also very convenient instruments when the quantity to be operated on is small; and especially when the substance is to be subjected to heat, as in the reduction of arsenic, &c.

CRYSTALLIZATION.

The operation of crystallization consists in the conversion of a fluid into a solid, in such a manner that the latter shall assume a regular geometrical form. The formation of crystals depends on the regular arrangement of atoms, and for this purpose time and freedom of motion are necessary. Hence the first step in the process of crystallization is to bring the body to a liquid or gaseous form, which may be

effected by heat alone, as the metals in fusion ; by solvents alone, as in an aqueous solution of common salt ; or by both combined, as in a hot and saturated aqueous solution of nitre. The next step in this operation is to remove slowly the causes of this liquid or aeriform condition. This is done by cooling the substance we wish to crystallize, by evaporating the menstruum, or in the case of hot solutions, by either of these means. The liquor which remains after the separation of the crystals, is called *mother water*. The term *amorphous* is applied to such solid substances as have no crystalline form.

An attention to the crystalline form which a body assumes is one of the best modes of determining its nature, and of ascertaining whether it is pure or adulterated. This character, therefore, has been particularly noticed in the descriptions of saline and other substances which are susceptible of crystallization. No general direction is of more consequence to those who wish to purchase articles in a state of purity, than that which relates to the selection, in all cases where it is practicable, of well crystallized samples.

For conducting the process of crystallization, a few common glass flasks which will sustain a moderate degree of heat, a few hessian crucibles, and glass capsules or earthen plates, will, in general, be quite sufficient.

PRECIPITATION.

This operation differs from crystallization, inasmuch as in precipitation the substance dissolved is converted to the solid state, not in a slow or gradual manner, but suddenly. This term is equally applicable whether the solid formed is crystalline or amorphous, or whether it sinks to the bottom of the vessel, or whether it ascends or remains suspended in the liquid. Precipitation may be caused either—1st. by modi-

fyng the solvent ; thus alcohol added to an aqueous solution of sulphate of lime, causes the separation of the salt in consequence of the change of the water into diluted alcohol.

2d. By separating some substance insoluble in the menstruum ; thus alumina is precipitated by the addition of ammonia to a solution of sulphate of alumina. Precipitation takes place also when, by the action of simple or compound chemical affinity, new combinations are formed which are insoluble in the menstruum ; thus oxalate of lime precipitates on adding oxalic acid to a solution of a salt of lime ; chromate of lead on mixing chromate of potassa with acetate of lead. In the above cases, and in many others, one of the new compounds remains in solution, but it sometimes happens that both products are precipitated ; for instance, when a solution of sulphate of magnesia is mixed with solution of baryta ; or a solution of sulphate of silver, with chloride of barium.

Precipitation is usually employed in qualitative analysis to detect substances by their colour, and the properties and relations, in general, which they exhibit when precipitated, either alone or in combination with other substances. The solid body separated by this process is called the *precipitate*, and the substance, which is the immediate cause of this separation, is termed the *precipitant*. For the sake of a more particular designation various terms are applied to precipitates, as, crystalline, pulverulent, flocculent, gelatinous, &c.

As precipitation is sometimes promoted by agitation and by heat, the vessels in which it is performed should admit of either of these operations. Test tubes are very convenient articles for this purpose. They enable us by closing the open end with the thumb to agitate the substance ; they bear heat sufficiently, and they permit the experimenter to inspect the whole process and to operate satisfactorily on very small quantities.

FILTRATION.

This operation is resorted to for the purpose of purifying liquids, and it consists in pouring the fluid from which the solid particles are to be removed, on a filter, for which purpose unsized paper, supported on a funnel, is usually employed. Such an apparatus allows the liquid to trickle through with ease, while it completely retains the solid particles. Filters are either smooth or plaited; the former are used in those cases where the solid substance is to be made use of; the latter, where the object is merely to clear the solution. Smooth filters, which are most frequently used, are formed by folding a circular paper doubly together, so that the folds form right angles. In conducting the filtration care should be taken that the filter does not reach over the brim of the funnel, and that the liquor does not rise quite to the top of the filter. It is well to moisten the filter previous to use, as then the filtration is not only more rapid, but the solid particles of the substances to be filtered are less liable to pass through the pores of the filter. It will also be found useful to have two kinds of paper always on hand, one of greater density for the separation of very minute precipitates, and the other of greater porosity for the speedy separation of grosser particles. The paper selected for the purpose should be as free as possible from inorganic substances, especially iron and lime. This can be determined by burning a piece of it, and testing the ash which remains. It may sometimes be advisable to wash the filters with dilute acid, to remove some substances which may interfere with the delicacy of certain processes. The funnels used in filtration should be either of glass or porcelain.

DECANTATION.

This operation consists in pouring off the clearer part of

a fluid after the substances which disturb its transparency are deposited at the bottom of the vessel. In order to pour such a body from a large mouthed vessel into a small mouthed one, the following expedient is sometimes resorted to. Apply a little tallow to the edge of the larger vessel, hold the middle of the glass rod against the tallow, and then, by inclining the larger vessel, make the liquid run gently down the rod into the vessel placed below to receive it. The tallow prevents the liquor from running down the outside of the large vessel. Sometimes a syphon, or a glass pipette, may be advantageously used for removing a liquid from a precipitate.

EDULCORATION.

Edulcoration, or rincing, is an operation employed to free the substance collected on a filter from any portion of the liquid which is still adhering to it. This may be most conveniently performed by an instrument called a *dropping* or *syringe bottle*, which is a glass vessel, stopped with a perforated cork, into which a small glass tube is fitted, drawn out at the top into a fine point. If air be blown through this tube into the flask, and when the air is sufficiently compressed, the flask is reversed, so that the inner aperture of the tube comes under water, a minute stream of water is expelled, peculiarly adapted to the rincing of precipitates.

EVAPORATION.

This is a chemical operation performed upon a solution, by means of which those parts which can be converted into vapour are driven off, and the solid matter remains behind. Thus it serves to remove from a saline solution a part of its water so that the salt may crystallize. In this process the water, alcohol, or other liquid employed for solution is entirely disregarded, the only object being to obtain the solid

substance. Ordinarily this object is attained by placing the solution in a shallow basin of glass or porcelain and subjecting it to heat. The best mode of applying heat is by means of a sand or water bath; but in some cases the flame of a coal fire or of a spirit lamp is employed. This process is also occasionally effected by placing the liquid in confined air, constantly kept dry by substances which have a great attraction for moisture. Concentrated sulphuric acid, slacked lime, and chloride of calcium, are the cheapest and most efficient bodies belonging to this class.

DISTILLATION.

This operation has for its object the separation of a volatile liquid from a less volatile or fixed substance, and the recovery of the evaporating fluid. For this purpose the liquid is converted into vapour by the application of heat, and the vapour again condensed. Distillation is performed by means of a glass retort and receiver, or of a copper still and refrigerator. The retort and receiver are usually employed when the operation is conducted upon a small scale. The liquid is introduced into the retort and heated by the flame of a spirit lamp, while the vapour thus formed is again condensed, or converted into a liquid in the receiver, which is kept cold by the dropping of water through a funnel containing a filter, or by surrounding it with ice or snow.

SUBLIMATION.

This is a process by which volatile substances are raised by heat, and again condensed in the solid form. Sublimation is consequently a distillation of solid bodies. It is generally employed for the separation of substances of different degrees of volatility, and is of great importance in analysis; as, for example, in the detection of arsenic. The apparatus for performing this operation is very simple; a small glass

matrass, or test tube, being generally sufficient for the sublimation of small quantities of matter. In many cases, two crucibles of different sizes may be employed for the same purpose. The mixture is put into the larger crucible, which may then be subjected to heat in a sand bath, the other being inverted and luted to the first ; a small aperture must be left at the edge for the escape of gaseous matter, or a hole may be bored in the smaller crucible, and a glass tube inserted in it.

IGNITION.

This is an operation which is often necessary to make a substance red hot, either to free it from water or to decompose or clear any organic bodies which it may contain. It is usually performed in a crucible, the selection of which must depend upon the nature of the body to be operated on. In most cases a common hessian crucible will answer the purpose, but sometimes a platinum one is necessary. With care the latter instrument may be used for many years ; but some precautions are necessary, which will be found in the article PLATINUM, in the body of this work. A piece of platinum foil, two inches long and an inch broad, or a small platinum spoon will also be found very useful in various operations which have been described. The heating of these instruments may be effected by a charcoal furnace or a spirit lamp. When a platinum crucible is put into a charcoal fire it should be protected by a hessian crucible having a smaller one inverted in it.

TESTING.

The liquid to be tested should be put into a wine glass or test tube. A few drops only of the liquid are to be employed ; and the tests, which are usually liquid, must be added in small quantity. Sometimes it will be sufficient to dip

the end of a clean glass rod into the test, and then stir the liquid with it. Flat plates of glass or porcelain are useful where small quantities of a liquid are to be tested. White paper may be employed for the same purpose, and the liquid may be tested by means of glass rods or camel's hair pencils. Sometimes a considerable quantity of the test is necessary in order to redissolve the precipitate produced by a small quantity of it. In such cases especially, the test liquid should be dropped in very gradually. This precaution is the more necessary as the most common mistake of those who are not much accustomed to the processes of analysis, is the addition of the reagents in too large quantities.

II.—PREPARATION OF TESTS OR REAGENTS.

Reagents, often also called *tests*, are substances which indicate the presence of other bodies by some striking phenomena, caused by their mutual action upon each other. Thus, a solution of baryta, when added to sulphuric acid, gives a dense white precipitate of sulphate of baryta. And as these two bodies have a most powerful attraction for each other, chloride of barium, or the acetate or nitrate of baryta, may be employed as a test for sulphuric acid. In this case, however, there is a circumstance which should not be overlooked. It is that several other acids cause a white precipitate with the chloride of barium or the salts of

baryta, but all the compounds thus formed, with the exception of the sulphate, (and the seleniate, which is very rarely met with,) are soluble in muriatic acid. If, then, the chloride of barium, when added to a liquid, causes the formation of a white precipitate, insoluble in muriatic acid, it is a sufficient evidence that it contains sulphuric acid.

The peculiar colour of the compound formed by adding a reagent to a liquid, is another phenomenon which leads to a correct judgment concerning the nature of bodies which it may contain. Thus, chromate of potassa gives with a solution of acetate or nitrate of lead a precipitate of chromate of lead, (chrome yellow,) the colour of which is so peculiar and so different from that of the precipitates which result from the mixture of this reagent with other solutions, that we may safely consider it as a proof of the presence of oxide of lead. So also the blue precipitate caused by ferrocyanide of potassium, and the reddish brown precipitate which results from the addition of ammonia, afford decisive evidence that oxide of iron is one of the constituents of the liquid which exhibits these phenomena.

In some cases also, the peculiar effect produced by an acid upon a substance under examination will serve to determine its nature, or at least to distinguish it from another which it resembles. Thus, sulphuric acid, when poured upon chalk, causes effervescence in consequence of the separation of carbonic acid, but no such effect is produced when plaster of Paris is treated in like manner.

Occasionally the effect of heat upon bodies is so different as to constitute a sufficient ground of distinction. Thus, saltpetre deflagrates when thrown upon burning charcoal, while Glauber's salt, for which the former is sometimes mistaken, when subjected to this trial, simply undergoes watery fusion.

Reagents are conveniently divided into two classes, according as the fluid state of substances, indispensable to

their action, is caused either by the application of heat or by means of liquid solvents ; viz., 1, *Reagents in the humid way* ; and 2, *Reagents in the dry way*.

To render this manual as complete as possible, processes will be here given for preparing the reagents which are employed in the operations already described. It is scarcely necessary to observe that these substances must be chemically pure ; unless this is the case, the results which they produce cannot be relied on. The reagents should therefore be carefully tested as to their purity before they are employed in experiments. The common impurities will be noticed when treating of each reagent in particular, but more full details will usually be found under the proper head in the body of the work.

The classification of reagents here introduced, is that of Fresenius. It is as follows :

A.—REAGENTS IN THE HUMID WAY.

1.—GENERAL REAGENTS.

a. Reagents principally used as SIMPLE SOLVENTS.

- | | |
|-----------|-------------|
| 1. Water, | 2. Alcohol. |
|-----------|-------------|

b. Reagents principally used as CHEMICAL SOLVENTS.

- | | |
|------------------------|------------------------|
| 3. Muriatic acid, | 6. Acetic acid, |
| 4. Nitric acid, | 7. Muriate of Ammonia. |
| 5. Nitromuriatic acid, | |

c. Reagents which serve especially to separate, or otherwise to characterize groups of substances.

- | | |
|--------------------------------|-----------------------------|
| 8. Litmus, | 13. Sulphuret of potassium, |
| 9. Turmeric, | 14. Potassa, |
| 10. Sulphuric acid, | 15. Carbonate of potassa, |
| 11. Sulphuretted hydrogen, | 16. Ammonia, |
| 12. Hydrosulphuret of ammonia, | 17. Carbonate of ammonia, |

- | | |
|-------------------------|--------------------------|
| 18. Chloride of barium, | 20. Chloride of calcium, |
| 19. Nitrate of baryta, | 21. Nitrate of silver. |

2. SPECIAL REAGENTS.

a. Reagents which serve especially for the detection of various BASES.

- | | |
|--------------------------------|----------------------------|
| 22. Sulphate of potassa, | 30. Bitartrate of potassa, |
| 23. Phosphate of soda, | 31. Protochloride of tin, |
| 24. Chromate of potassa, | 32. Chloride of gold, |
| 25. Ferrocyanide of potassium, | 33. Chloride of platinum, |
| 26. Ferricyanide of potassium, | 34. Zinc, |
| 27. Oxalic acid, | 35. Iron, |
| 28. Oxalate of ammonia, | 36. Copper. |
| 29. Tartaric acid, | |

b. Reagents which are particularly applied to the detection of various ACIDS.

- | | |
|----------------------------|--------------------------------|
| 37. Acetate of potassa, | 43. Ammonio-nitrate of silver, |
| 38. Caustic lime, | 44. Sulphurous acid, |
| 39. Sulphate of lime, | 45. Chlorine, |
| 40. Protosulphate of iron, | 46. Solution of indigo, |
| 41. Acetate of lead, | 47. Starch paste, |
| 42. Sulphate of copper, | 48. Tincture of iodine. |

B.—REAGENTS IN THE DRY WAY.

- | | |
|---------------------------|-------------------------|
| 49. Charcoal, | 51. Nitrate of potassa. |
| 50. Cyanide of potassium, | |

1.—WATER.

Pure water is obtained by distilling spring water from a glass retort or copper still. This distillation should not be carried beyond three-fourths of its quantity. Rain water

received in the open air can, in most cases, be substituted for distilled water.

Water is chiefly employed as a simple solvent. It is, however, sometimes used for the decomposition of some neutral metallic salts causing the formation of soluble acid and insoluble basic compounds ; this is especially the case with nitrate of bismuth and chloride of antimony.

2.—ALCOHOL.

Two sorts of alcohol are used in chemical analysis. 1st. spirit of wine of 0.83 or 0.84 ; and 2d. absolute alcohol. The latter may be obtained by distilling the former with the addition of fused chloride of calcium. It should volatilize without leaving any residue, and should not redden litmus.

As some bodies are soluble in alcohol and others are insoluble, it is often employed for the separation of the former from the latter. Thus chloride of strontium may be separated by it from chloride of barium. By alcohol, also, substances which are insoluble in it are precipitated from their solution in water. Various substances are moreover detected by the peculiar tint which they give the flame of alcohol, as boracic acid, soda, and strontia.

3.—MURIATIC OR HYDROCHLORIC ACID.

A mixture of thirteen and a half parts of oil of vitriol and four parts of water, when cold, is poured upon eight parts of common salt retained in a retort ; the neck of the retort is then somewhat raised, and the heat of the sand bath applied to the latter, as long as the gas passes over. The gas evolved is, by means of a bent tube, transmitted through twelve parts of water in a glass flask, which must be kept constantly cool. In order to prevent the gas from receding, the tube is only permitted to dip about one line into the water of the receiver. If the sulphuric acid contains nitric

acid, the gas which passes over first, (and which in that case contains chlorine,) must be received separately. The muriatic acid thus produced is tested as to its specific gravity, and diluted with water until its specific gravity is 1.11 or 1.12.

Muriatic acid is used generally for the solution of a great variety of bodies, as, metals, oxides and peroxides; also to expel weaker acids from their salts, as, carbonic acid, sulphuretted hydrogen, &c. It precipitates oxide of silver, protoxide of mercury and oxide of lead, and detects free ammonia by producing dense white fumes of sal ammoniac in the air.

4.—NITRIC ACID.

To separate the sulphuric and muriatic acids which are almost always contained in the nitric acid of commerce, add a solution of nitrate of silver as long as any precipitate of chloride of silver is formed. Let this precipitate subside, decant the supernatant acid into a retort, and distill to within a fraction of its whole amount. The distilled acid is then, if necessary, diluted with water, till it has a specific gravity of 1.20.

Nitric acid is constantly employed in the solution of metals, oxides, sulphurets, &c. It parts readily with a portion of its oxygen, and it, therefore, serves as the most common means of oxidation; thus it is used to convert protoxide of iron into peroxide, to decompose hydriodic acid, and the iodides, &c.

5.—NITROMURIATIC ACID. AQUA REGIA.

This is prepared by mixing one measure of pure nitric acid with three or four measure of pure muriatic acid.

Nitromuriatic acid is the most powerful solvent that we possess for metals, except those which form insoluble com-

pounds with chlorine. It is used chiefly for the solution of gold and platinum, and for the decomposition of various sulphurets, as cinnabar, &c.

6.—ACETIC ACID.

Pure acetic acid may be obtained by rubbing ten parts of crystallized neutral acetate of lead together with three parts of anhydrous sulphate of soda, pouring the mixture into a retort, adding a cooled mixture of two and a half parts of sulphuric acid, with an equal weight of water, and distilling to dryness in a sand bath. The receiver may be connected with the retort in the usual way, or by means of Liebig's condensing apparatus.

Acetic acid is used in analysis for the acidulation of liquids, where we wish to avoid the employment of the mineral acids. Its unequal power of solution for different substances, enables us also, by its means, to distinguish certain bodies from each other. Thus, phosphate of lime is distinguished from oxalate of lime, by its solubility in acetic acid.

7.—MURIATE OF AMMONIA. SAL AMMONIAC.

The sal ammoniac of commerce may generally be purified for the purpose of chemical analysis by simple crystallization. For use, as a reagent, one part of the salt is dissolved in eight parts of water.

Sal ammoniac is employed chiefly for the purpose of keeping in solution certain oxides, as protoxide of manganese, magnesia, or certain salts, as tartrate of lime, when other oxides or salts are precipitated by ammonia, or by some other reagent. This use depends upon the tendency of the ammoniacal salts to form double combinations with other salts. Sal ammoniac is moreover specially employed to precipitate platinum as ammonio-chloride of platinum.

8.—LITMUS.

To prepare blue litmus paper, digest one part of commercial litmus with six parts of water. The intensely blue liquid is divided into two parts, and the free alkali contained in the one-half saturated by stirring it repeatedly with a glass rod dipped into very dilute sulphuric acid, until the colour exhibits a shade of red ; the other blue half is added and the whole poured into a cup, and slips of fine unsized paper are dipped into this tincture. These slips are then suspended on threads for the purpose of drying. The colour of litmus paper must be uniform, and neither be too light nor too dark.

This paper serves for the detection of free acids in liquids, since its blue colour becomes thereby changed into red. It should be recollected, however, that it undergoes the same alteration by the neutral salts of most metallic oxides.

Reddened litmus paper is prepared by repeatedly stirring the blue litmus tincture with a glass rod dipped into dilute sulphuric acid, until its colour has assumed a distinct shade of red. Slips of paper are then dipped into this tincture. They must be distinctly red when dry.

The blue colour of reddened litmus paper is restored by pure alkalies and alkaline earths, as well as by their sulphur combinations, by alkaline carbonates, and also by the soluble salts of several other weak acids, especially of boracic acid.

9. TURMERIC.

Turmeric paper may be prepared by digesting and heating one part of bruised turmeric root with six parts of dilute spirit of wine. The tincture obtained is filtered, and slips of unsized paper are dipped into it. Turmeric paper, when dry, must have a fine yellow colour

Turmeric serves for the detection of the free and carbonated alkalies, which change its fine yellow to a very characteristic brown colour. Several other bodies, however, effect a similar change of colour, as boracic acid. Turmeric paper may be employed as a test for acids by dipping them into a weak solution of potassa or soda, and then drying them. An acid restores the original yellow colour.

All reagent papers should be kept in well-closed glass bottles or small boxes.

10.—SULPHURIC ACID. OIL OF VITRIOL.

This acid sometimes contains nitric acid, lead, and arsenic. The mode of detecting these impurities will be found under this article in the body of the work. Boiling and distillation will separate nitric acid and lead. Arsenic must be thrown down by sulphuretted hydrogen, and the supernatant acid must then be distilled.

Sulphuric acid, in consequence of the great affinity which it has for bases, is used for the liberation and expulsion of other acids, especially the phosphoric, boracic, muriatic, nitric, and acetic. It liberates iodine from the iodides by oxidizing the metals, the sulphuric acid being at the same time changed into the sulphurous acid. It is also employed for the liberation of certain gases, especially hydrogen and sulphuretted hydrogen. Sulphuric acid is besides employed for the detection and precipitation of baryta, strontia, and lead. The acid used for this purpose is diluted with four parts of water.

11.—SULPHURETTED HYDROGEN.

Mix intimately thirty-two parts of iron filings with twenty-one parts of sublimed sulphur, divide into small portions and gradually project them into a crucible heated to redness, and before adding new portions wait until the

last are red hot. After the entire mixture has thus been fused, the crucible is well covered, and allowed to remain a short time longer exposed to the fire. The sulphuret of iron thus obtained, when cool, is broken into lumps, and put into a bottle for use. When sulphuretted hydrogen gas is required, a portion of the bruised sulphuret of iron is put into a tubulated retort, with the end of the tube bent downward at a right angle. It is then covered with water, and concentrated sulphuric acid added through a funnel tube. The evolved gas may then be made to act upon any solution. Should it be required of great purity it may be transmitted through water contained in a Woulfe's bottle.

Sulphuretted hydrogen water is prepared by conducting the gas obtained in the preceding process into water of the lowest possible temperature until it is saturated, consequently until the whole volume of gas added in excess begins to escape completely unabsorbed. It should be kept in well-closed bottles, placed in an inverted position into small vessels filled with water. It must be clear, have the strong odour of the gas, and yield a copious precipitate of sulphur when heated with chloride of iron. It should not assume a blackish tint upon the addition of ammonia.

Sulphuretted hydrogen is an invaluable test of the metals. It decomposes various metallic oxides forming water and sulphurets; the latter being usually insoluble in water, form precipitates, which sometimes have so distinct a colour that we are enabled to determine the particular metals they contain. Some of these sulphurets are soluble in the alkalies and alkaline sulphurets, while others are not. The sulphurets of arsenic and of cadmium are thus distinguished.

12.—HYDROSULPHURET OF AMMONIA.

This liquid is formed by transmitting sulphuretted hydrogen through solution of ammonia, to complete saturation, or

till it no longer causes precipitation in a solution of sulphate of magnesia. It should be kept in well-closed bottles inverted in water. It should be transparent and evaporate without residue. Sometimes it has a yellow tinge, owing to the formation of sulphuret of ammonium. It then yields sulphur when mixed with acids, which ought to be overlooked in experiments.

Hydrosulphuret of ammonia is employed for the precipitation of those metals, the sulphurets of which are soluble in acids. It may be considered as a reagent in which sulphuretted hydrogen acts in conjunction with ammonia. In some instances, however, it precipitates bodies by the sole action of its ammonia, as, for example, the hydrated oxides of aluminum and of chromium.

13.—SULPHURET OF POTASSIUM.

This reagent, which should be used immediately after its preparation, may be obtained by boiling sulphur, in proper proportions, with solution of caustic potassa.

It is substituted for hydrosulphuret of ammonia in the separation of certain sulphurets where one of them is soluble in the latter reagent. Thus sulphuret of copper should be separated from sulphuret of tin by sulphuret of potassium, because the former is not quite insoluble in hydrosulphuret of ammonia.

14.—CAUSTIC POTASSA.

This can now be obtained in the chemical shops in a state of considerable purity, except a little silica and carbonate of potassa, which last is formed by the frequent opening of the bottles in which it is kept. It may be prepared by the addition of hydrate of lime in small portions to an ounce of carbonate of potassa dissolved in twelve ounces of water, the solution being kept at a boiling heat in a clean iron pan.

The hydrate of lime is to be added until a portion of the liquid thus obtained no longer causes any effervescence when filtered into muriatic acid. The pan is then taken from the fire, the carbonate of lime allowed to subside, and the supernatant liquid filtered through bleached linen and rapidly evaporated in a clean iron pan or silver basin until four ounces only remain. It should be kept in small bottles shut by a ground glass cover, or if a stopper is used a slip of paper should be rolled round it, otherwise it will be impossible in a short time to take the stopper out.

Potassa is an exceedingly useful reagent. By its great affinity for acids it decomposes the salts of most bases and precipitates from their solution all those salts which are insoluble in water. As some of the oxides are soluble in excess of potassa, while others are not, it is employed to separate them. Thus alumina, which is soluble in potassa, may be separated from oxide of iron, which is not. Many of the precipitates produced by potassa exhibit particular colours or other characteristic properties, by which the nature of the metals they contain may be detected.

15.—CARBONATE OF POTASSA.

Pure carbonate of potassa for chemical use, is prepared by calcining purified cream of tartar in an iron pan to complete carbonization: the residue is then boiled with water. The solution thus obtained is purified by filtration and evaporated to dryness in a clean iron pan, the mass being constantly stirred during the latter part of the process. The residuary dry salt is kept in a well-closed bottle. For use, one part of it is dissolved in five parts of water.

This reagent precipitates all bases, with the exception of the alkalies, most of them as carbonates, but also a few as oxides. Many of the precipitates exhibit particular colours and it may thus serve for the detection of the various metals.

It is used also to detect tartaric acid and to precipitate platinum from solutions containing muriatic acid.

16.—AMMONIA.

The solution of ammonia, when purchased, should be carefully tested in the manner described under this article in the preceding part of this work. If it cannot be obtained in the shops in a state of purity it may be prepared by mixing four parts of recently slacked quicklime with five parts of powdered sal ammoniac in a glass retort, and carefully adding as much water as will cause the powder to form into lumps when agitated. The retort is then placed in a sand bath, and brought into connexion with two gas-conducting tubes, joined to each other in the middle by means of a rinsing apparatus, containing only a small quantity of water. The absorbing receiver should contain ten parts of water, and be placed in snow or in cold water. Heat is then applied to the retort, and continued until no more bubbles appear, when the stopper of the retort must be quickly removed to prevent the fluid from receding. The water in the receiver contains about sixteen per cent. of ammonia, and has a specific gravity of 0.93. It should be kept in bottles closed with glass stoppers.

Ammonia is a most valuable reagent, being used for the saturation of acid liquids, and for the precipitation of a great number of metallic oxides, as well as for their separation from each other. Some of the metallic oxides are dissolved by an excess of ammonia, and may thus be separated from others, which are not.

17.—CARBONATE OF AMMONIA.

For chemical analysis the sesquicarbonate of ammonia is employed. It must be entirely free from any smell of animal oil. The outer surface of the mass must be scraped off,

and then one part of the salt dissolved in a mixture of four parts of water, and one part of solution of ammonia.

This salt precipitates most metallic oxides like carbonate of potassa. In some cases boiling is necessary in order to effect the complete precipitation. Several of the precipitates dissolve again when this reagent is added in excess. Carbonate of ammonia is especially employed for the precipitation of baryta, strontia, and of lime, and for the separation of these substances from magnesia, as the latter is not precipitated when the ammoniacal salts are present.

18.—CHLORIDE OF BARIUM.

This compound may be prepared as follows: Mix six parts of pure heavy spar (sulphate of baryta) with one part of powdered charcoal and one and a half of flour; put the mixture in a hessian crucible, and expose it to the strongest possible red heat. Rub the fused mass to powder when cool; boil about nine-tenths of the powder with four times their weight of water, and add muriatic acid till no more effervescence of sulphuretted hydrogen takes place, and the liquid manifests an acid reaction. Then add the last tenth of the fused mixture, and continue the boiling for some time. The alkaline liquid is then filtered and crystallized. The crystals when dry are digested and washed with alcohol, redissolved in water, and again crystallized. For use one part of the crystals is dissolved in ten parts of water.

This reagent is particularly valuable as a means of detecting the presence of sulphuric acid, whether free or in the form of a salt, causing a white precipitate of sulphate of baryta. Carbonic acid also decomposes this substance, and forms with it carbonate of baryta, which is insoluble in water. In order therefore to determine whether a precipitate produced by the addition of this salt to a solution is owing to the presence of sulphuric acid, it must be treated with

dilute muriatic or nitric acid. If the precipitate is dissolved, or if it loses weight, by this treatment, it either wholly or in part consists of carbonate of baryta.

19.—NITRATE OF BARYTA.

A dilute solution of chloride of barium is boiled, and carbonate of ammonia added, as long as it causes any precipitate, and further until the liquid manifests an alkaline reaction. The carbonate of baryta thus obtained is carefully washed, and then dissolved in hot and dilute nitric acid until the liquid is entirely neutral. The solution is then filtered and crystallized by evaporation. One part of the salt is dissolved in ten parts of water.

This reagent is employed for the same purposes as chloride of barium, and may be substituted for it in those cases where it is desirable to avoid the formation of a chloride in the liquid under examination.

20.—CHLORIDE OF CALCIUM.

Chalk is added to hot and dilute muriatic acid, until acid reaction ceases; the solution is then filtered, and, with the addition of some ammonia, allowed to stand a few hours at a moderate heat. It is then filtered again; the clear solution is heated to boiling, and carbonate of ammonia added until all the lime is precipitated; the carbonate of lime thus obtained is carefully washed. A mixture of one part of pure muriatic acid with five parts of water, is then heated, and the washed carbonate of lime added to complete neutralization. The solution is then boiled up several times, and preserved for use. It should be perfectly neutral, and neither tinged nor precipitated by hydrosulphuret ammonia; nor should it evolve ammonia when mixed with potassa or hydrate of lime.

This reagent, in its action and application, is analogous to

chloride of barium. It precipitates some of the organic acids, while it forms soluble combinations with others. Thus tartaric acid gives with it a precipitate of tartrate of lime, and may in this way be separated from citric and malic acids, the lime salts of which are soluble.

21.—NITRATE OF SILVER.

Dissolve standard coin in nitric acid, evaporate the solution to dryness, fuse the residue in a small porcelain crucible at a moderate heat, by means of a spirit lamp, till all the nitrate of copper is decomposed, and a portion dissolved in water becomes no longer blue when ammonia is added in excess. The mass, when cooled, is boiled with water, filtered and crystallized. One part of the crystals is dissolved in twenty parts of water for use. As usually obtained, this substance is largely adulterated.—(See the article SILVER, NITRATE OF.)

Nitrate of silver affords an excellent means for distinguishing and separating the compounds of chlorine, iodine, bromine and cyanogen; the other insoluble silver combinations being soluble in dilute nitric acid. It is also very useful in detecting individual acids, many of the silver precipitates exhibiting a particular colour, as for example, chromate and arseniate of silver.

22.—SULPHATE OF POTASSA.

The sulphate of potassa of commerce is purified by crystallization, and one part of the pure salt is dissolved in twelve parts of water for use.

Sulphate of potassa precipitates from solutions of baryta and strontia, and of lime when highly concentrated, the sulphates of the oxides which are insoluble in water. The action of this reagent is analogous to that of sulphuric acid,

and may, in many cases, be preferable to it, as it does not disturb the neutrality of the solution.

23.—PHOSPHATE OF SODA.

Dilute commercial phosphoric acid is heated, and solution of carbonate of soda added, till all effervescence ceases, and the liquid manifests a feeble alkaline reaction. The liquid is then filtered, evaporated and crystallized. The crystals are dried, triturated with a portion of charcoal and flour, and the entire mass strongly heated in a hessian crucible. The heated mass is then boiled with water, filtered and crystallized. One part of the salt obtained is dissolved in ten parts of water for use. This solution must not become turbid on being heated with ammonia. The precipitates produced by the addition of solution of baryta and of silver must completely redissolve on the addition of dilute nitric acid.

Phosphate of soda is employed in analysis, after the separation of the heavy metallic oxides, as a test for alkaline earths in general; and after the separation of baryta, strontia and lime, with simultaneous addition of ammonia, as a test for magnesia, which, under these circumstances, precipitates, as basic phosphate of ammonia and magnesia.

24.—CHROMATE OF POTASSA.

Dissolve the commercial bichromate of potassa in water, and add carbonate of potassa, till the solution manifests a feeble alkaline reaction. The liquid is then crystallized. The crystals are well washed and redissolved in water, in the proportion of one part of the crystals to ten parts of water. The solution must be neutral.

Chromate of potassa, by double affinity, decomposes most of the metallic salts. These metallic chromates usually have a striking colour, from which the metals they con-

tain may be easily detected. Chromate of potassa is, however, principally used as a test for lead.

25.—FERROCYANIDE OF POTASSIUM—YELLOW PRUSSIAN OF POTASH.

Commercial ferrocyanide of potassium is in general sufficiently pure for the purposes of chemical analysis. One part is dissolved in twelve parts of water for use.

This reagent forms with most metals combinations insoluble in water, and often very peculiarly coloured. It is principally used for the detection of oxide of copper and peroxide of iron, with the former of which it gives a reddish brown precipitate, and with the latter, a fine blue one.

26.—FERRICYANIDE OF POTASSIUM—RED PRUSSIAN OF POTASH.

This reagent is prepared by transmitting chlorine gas through a solution of one part of ferrocyanide of potassium in ten parts of water, till a portion of the liquid, when added to a solution of perchloride of iron, no longer produces a blue precipitate, or even a blue tinge. The solution is then concentrated by evaporation, and some carbonate of potassa added, until a feeble alkaline reaction becomes manifest. The liquid is then filtered and allowed to cool. The crystals obtained are of a magnificent red colour. One part is dissolved in ten parts of water for use.

This reagent decomposes solutions of metallic oxides like the preceding. It is especially useful as a test for protoxide of iron with which it produces a fine blue precipitate, while it does not cause a precipitate in solutions containing the peroxide of that metal.

27.—OXALIC ACID.

This acid can now be usually obtained in commerce in a state of sufficient purity, if subjected to a re-crystallization.

It may be prepared by pouring upon one pound of starch, contained in a porcelain basin, five parts of nitric acid, of sp. gr. 1.42, diluted with two parts of water, and applying a gentle heat till no more nitrous gas is evolved. The liquid is then filtered and crystallized; the crystals obtained are drained and purified by a second crystallization. Oxalic acid must be preserved in the form of powder, as it decomposes in solution.

Oxalic acid combines with many bases, forming salts insoluble in water, and it may therefore be used to precipitate these bases. Many of the oxalates are soluble, while others are insoluble, in excess of oxalic acid. This reagent is of great value, in analysis, for the detection and precipitation of lime, but for this purpose it is necessary that the solution should be neutral, as the oxalate of lime is soluble in the stronger acids

23.—OXALATE OF AMMONIA.

This reagent is prepared by dissolving oxalic acid in water, adding ammonia till a feeble alkaline reaction takes place, and crystallizing. One part of the salt is dissolved in twenty-four parts of water for use.

Oxalate of ammonia is conveniently employed instead of oxalic acid and ammonia. It possesses this advantage over the free acid, that its solution does not decompose by keeping.

23.—TARTARIC ACID.

The tartaric acid of commerce, when crystallized, is usually sufficiently pure for the purposes of testing. It should be kept in powder, since its solution, after a time, decomposes with the formation of a white film.

This reagent may be employed to separate some metals, the solution of which in tartaric acid prevents the precipita-

tion by alkalies, from others which it does not. It affords one of the best means of distinguishing potassa from soda, as with the former it gives rise to a crystalline, difficultly soluble salt, which is not the case with the latter.

30.—BITARTRATE OF POTASSA.

The cream of tartar of commerce should be subjected to the tests heretofore given before it is used for chemical purposes. It should be preserved in powder, as the solution, when kept for any length of time, undergoes change.

As many metals dissolve in a hot solution of cream of tartar, while others do not, this reagent may be employed to separate the former from the latter. It is employed in certain cases to separate oxide of antimony from oxide of tin.

31.—PROTOCHLORIDE OF TIN.

To obtain this reagent English tin is reduced to powder by being fused in an iron spoon, then taken from the fire and rubbed in a mortar till it has assumed the solid state. This powder is then for some length of time, boiled with concentrated muriatic acid in a glass vessel, care being taken that the tin is in excess; the solution is diluted with four times the quantity of water, slightly acidulated with muriatic acid, and filtered. The clear solution is kept in a closed bottle containing small pieces of metallic tin, without which it is soon converted into the perchloride.

Protochloride of tin is principally employed for the detection of mercury and gold. For the latter purpose it must be mixed with some nitric acid without the application of heat.

32.—CHLORIDE OF GOLD.

As this substance has recently been introduced into the Daguerreotype process, it can be obtained in a state of con-

siderable purity. It may be prepared by dissolving gold in aqua regia with the application of a gentle heat until the acid takes up no more of the gold. If the gold was alloyed with copper, which is detected by the brown precipitate produced by ferrocyanide of potassium in a portion of the solution diluted with water, the gold solution containing copper is mixed with sulphate of iron in excess. The gold becomes reduced, and separates as a fine brownish black powder; it is then washed in a small retort, redissolved in aqua regia, the solution evaporated to dryness in the water-bath, and the residue dissolved in thirty parts of water. If the gold is alloyed with silver, the latter metal remains undissolved as chloride of silver, when treated with aqua regia. In this case the first solution is evaporated to dryness, and the residue dissolved for use.

This reagent is used in analysis for the detection of protoxide of tin, as it produces a purple precipitate, or a purple colour in solutions containing this substance.

33.—CHLORIDE OF PLATINUM.

Boil platinum, in powder, in nitric acid for the purpose of purification, and then, in a retort with a narrow neck, drench it with concentrated muriatic acid, and some nitric acid; apply gentle heat, and, from time to time, add some nitric acid, until all the platinum is dissolved. The solution is, with the addition of muriatic acid, evaporated to dryness by a water-bath, and the residue dissolved in ten parts of water.

Chloride of platinum forms very sparingly soluble double salts, with chloride of potassium and muriate of ammonia, whilst it enters into no such combination with chloride of sodium. It serves, therefore, to detect ammonia and potassa, and is indeed nearly the most susceptible reagent for the latter substance that we possess.

34.—ZINC.

Pure sublimed zinc is selected for chemical purposes. It must be free from arsenic. The pure zinc should be fused and a portion of it gradually dropped into a large vessel containing water. The remainder should be poured into wooden moulds, coated with chalk, for the purpose of casting it into little cylinders.—(See the article ZINC.)

Zinc precipitates many metals in their metallic state, owing to its great affinity for oxygen and that of its oxide for acids. It is especially employed for the detection of antimony and tin.

35.—IRON.

This metal, like zinc, precipitates many metals in a pure state. It is especially employed for the detection of copper, which is precipitated on it with its characteristic colour.

36.—COPPER.

This metal is employed for the reduction of mercury, which precipitates thereon as a white coating, which shines with a silvery lustre when rubbed. Any clean copper surface will answer the purpose.

37.—ACETATE OF POTASSA.

This reagent is obtained by dissolving one part of pure carbonate of potassa in two parts of water, heating the solution and exactly saturating it with acetic acid.

The acetate of potassa is peculiarly adapted for the detection of tartaric acid as the precipitated tartar is insoluble in the liberated acetic acid. It should be prepared when needed.

38.—CAUSTIC LIME.

Newly prepared hydrate of lime is agitated and digested for some time in cold distilled water, allowed to settle, and the clear fluid decanted and kept in a well-closed bottle. It should give a brown colour to turmeric paper and yield a considerable precipitate with carbonate of potassa.

Lime water is especially employed for the detection of carbonic acid, and to distinguish from each other paratartaric acid, tartaric acid and citric acid. Hydrate of lime serves also like caustic potassa to liberate ammonia from its union with acids.

39.—SULPHATE OF LIME.

Mix a concentrated solution of chloride of calcium with dilute sulphuric acid. The precipitate is well washed, digested, and for some time agitated with water, then allowed to settle, and the clear liquid decanted and kept for use.

This reagent is employed chiefly for the purpose of distinguishing baryta, strontia and lime from each other. Of course it cannot precipitate the latter, whilst it behaves with solutions of strontia and baryta in the same manner as highly dilute sulphuric acid. It precipitates baryta immediately, and strontia only after the lapse of some time.

40.—PROTOSULPHATE OF IRON.

Dissolve a quantity of clean iron nails in dilute sulphuric acid, with the aid of heat, having the iron in excess. Filter the solution, and after the addition of a few drops of sulphuric acid allow it to cool. If the solution is sufficiently concentrated, crystals are immediately obtained. The crystals are washed with water, slightly acidulated with sulphuric acid, dried and kept for use.

The use of the protosulphate of iron depends upon the great disposition which it has to absorb oxygen. It is,

therefore, a powerful means of reduction. It is employed for the detection of nitric acid, which it decomposes, and also for the detection and precipitation of gold.

41.—ACETATE OF LEAD.

This substance is procured in commerce, and its purity may be determined by the tests heretofore given. (See LEAD, ACETATE OF.) For chemical use it should be perfectly neutral and be dissolved in about ten parts of water.

The oxide of lead contained in this reagent forms, with a great many acids, combinations which are insoluble in water, and are distinguished by their colour or some characteristic property. Thus chromate of lead has a beautiful yellow colour, while malate of lead is distinguished by its easy solubility.

42.—SULPHATE OF COPPER.

The blue vitriol of commerce may be purified by repeated crystallization. Its entire purity may be determined by the tests given in the article COPPER, SULPHATE OF.

It is employed for the precipitation of hydriodic acid as protiodide of copper. For this purpose a solution of one part of the blue vitriol must be mixed with two and a quarter parts of protosulphate of iron, (or by charging it with excess of sulphurous acid,) or else one-half of the iodine will precipitate in a free state. The protoxide of iron in this process, changes to peroxide, by reducing the peroxide of copper to protoxide. By adding ammonia to a solution of the sulphate of copper until the precipitate which appears at first is redissolved, we obtain the ammonio-sulphate of copper which is employed as a test for arsenious acid.

43.—AMMONIO-NITRATE OF SILVER.

This reagent may be prepared by cautiously adding caustic ammonia to a solution of nitrate of silver, till the precip-

itate which at first appears is redissolved. It serves for the detection of arsenious and arsenic acid in solutions which contain a free acid.

44.—SULPHUROUS ACID.

To obtain this acid small pieces of charcoal are heated in a retort with six or eight times their weight of sulphuric acid, and the evolved gas is transmitted through water, (which must be kept cool,) till no more of the acid is absorbed. The solution thus obtained must be kept in well-closed bottles.

The employment of sulphurous acid depends chiefly upon its attraction for oxygen, and its consequent conversion into sulphuric acid. It is, therefore, a powerful means of reduction; it precipitates metallic mercury from its solutions, and converts chromic acid into oxide of chromium. It also converts arsenic acid into arsenious acid, by which means the arsenic is more surely precipitated by sulphuretted hydrogen.

45.—CHLORINE.

To one part of pounded peroxide of manganese, in a retort, are added four or five parts of commercial muriatic acid; a gentle heat is then applied to the retort, and the evolved gas is conducted into a jar containing from thirty to forty parts of water at the lowest possible temperature. The chlorine water obtained must be kept in a well-closed bottle, and cautiously protected from the influence of light.

Chlorine water is used for expelling iodine and bromine from their combinations. Its great attraction for hydrogen renders it useful in the destruction of organic substances.

46.—SOLUTION OF INDIGO.

One part of pounded indigo is heated with seven parts of strong sulphuric acid. The solution is diluted for use, with so much water that the liquid just appears distinctly blue.

As indigo is decomposed when boiled with nitric acid forming products which are of a yellow colour, this solution is employed for the detection of that acid, whether free and uncombined, or in its salts. In the latter case, however, the nitric acid must first be liberated by means of sulphuric acid.

47.—STARCH PASTE.

Common starch is rubbed with cold water, and the mixture then heated to the boiling point, being at the same time constantly stirred. The paste must be uniform, and so thin as almost to run. It must be used cold.

It is used as a test for the presence of free iodine, with which it forms a dark blue compound which is so intense that it is perceptible when the two substances are brought together in a very dilute state. With bromine starch forms a yellow precipitate, but it is a far less delicate test of this substance than of iodine. It should be recollected that starch does not form this blue compound with an iodide, unless some substance is added to liberate the iodine. Sulphuric acid usually answers the purpose.

48.—TINCTURE OF IODINE.

This is prepared by dissolving one part of pure and perfectly dry iodine in twelve parts of alcohol, by weight. It should be kept in well-stopped bottles.

This tincture is used as a test for starch, with which it forms a blue compound as above stated. In order to render the result certain the liquid to which it is added should be cold, as the iodide of starch loses its colour by heat.

49.—CHARCOAL.

The charcoal of pine or linden is said to be preferable for blow-pipe experiments. Smooth pieces should be selected. It should be kept in well-closed vessels.

Charcoal is principally used as a support for the matter under examination in blow-pipe experiments. It also serves for the reduction of arsenious and arsenic acids, by depriving them of their oxygen at a red heat. For this purpose the charcoal may be employed either in the form of small splinters or reduced to powder. It should be heated, under sand, before being used. Sometimes the reduction of arsenic is effected by a mixture of soda and lampblack, which should be heated in a covered crucible and kept in a well-stopped bottle. The *black flux* often also used for the reduction of arsenic is prepared by throwing into a red-hot crucible a mixture of two parts of cream of tartar with about one part of nitre. It should be carefully kept from the air, and when not recently made, be well dried before it is used.

50.—CYANIDE OF POTASSIUM.

To obtain this reagent, commercial ferrocyanide of potassium is gently heated and stirred, till its water of crystallization is completely expelled. It is then pounded, and eight parts of the dry powder are mixed with three parts of perfectly dry carbonate of potassa. This mixture is put into a crucible heated to redness, and the latter well closed and kept at a bright red heat, till the mass is in the state of fusion. The crucible is left at rest for a moment and then the clear salt is poured into a heated porcelain basin, taking care to prevent the passing over of any of the black sediment at the bottom, which is principally metallic iron in a state of minute division. The cyanide of potassium thus obtained, is mixed with a little cyanate of potassa, but this is no objection to its use in analysis.—(See page 274.) It must be perfectly white.

This substance excels almost all others as a reducing agent. By its use pure metals may be obtained from their combinations, often by merely heating the mixture in a por-

celain crucible over a spirit lamp. It is very valuable for the reduction of arsenites and arseniates, especially of some of those which have the heavy metals for bases, and the reduction of which by the usual processes is attended with some difficulty. The reduction of arsenite of silver, for example, may be effected by putting it into a test tube, and covering it with a small piece of cyanide of potassium. The moisture is first removed by heating the tube from below upwards, as in the common process for reducing arsenious acid by black flux. The cyanide of potassium is then fused, and a strong heat afterwards applied to the mixture; after some time the arsenic is completely sublimed, and if the tube is clean and dry, a beautiful mirror incrustation will be obtained. For the reduction of very small quantities of compounds of arsenic, Fresenius recommends the use of a perfectly dry mixture of carbonate of soda and of cyanide of potassium, covering the specimen with about six times its quantity of this mixture, and conducting the operation in a bulb test glass. Sulphuret of arsenic may also be reduced by fusing it with cyanide of potassium.

This reagent is moreover of great value in blow-pipe experiments.—(See Fresenius' work on *Chemical Analysis*.)

51.—NITRATE OF POTASSA.

Commercial saltpetre, the purity of which has been tested by the processes heretofore described, is to be dissolved to saturation in boiling water. The solution is then diluted with a small quantity of water, filtered into a glass vessel, surrounded by cold water, the solution being constantly stirred till cold. The crystalline powder thus obtained is thrown on a filter and washed with cold water till the clear solution is no longer troubled by nitrate of silver. It is then well dried and kept for use.

This reagent, in consequence of the ease with which it

yields oxygen when heated, is used to convert metallic sulphurets, as those of tin, of antimony, and of arsenic, into oxides and acids. It is also employed for the rapid and complete combustion of organic bodies.

III.—TABLES

EXHIBITING THE BEHAVIOUR OF SOME REAGENTS
WITH THE MORE IMPORTANT METALS, METALLIC
OXIDES, AND ACIDS.

(COMPILED FROM WILL'S OUTLINES OF QUALITATIVE ANALYSIS.)

Substances of rare occurrence are included in brackets.

TABLE I.

BEHAVIOUR OF SOLUTIONS OF THE METALS WITH
SULPHURETTED HYDROGEN AND HYDRO-
SULPHURET OF AMMONIA.

| ELEMENTS PRECIPITATED FROM THEIR ACID SOLUTION BY SUL- PHURETTED HYDROGEN AS SULPHURETS. | | | |
|--|----------|--|------------------------------------|
| <i>Soluble in hydrosulphuret of ammonia and reprecipitated by muriatic acid:</i> | | <i>Insoluble in hydrosulphuret of ammonia:</i> | |
| Antimony | orange | Mercury | } black or brownish black |
| Arsenic | } yellow | Silver | |
| Tin | | Lead | |
| Gold | | Bismuth | |
| Platinum | } black | Copper | } yellow |
| [Iridium] | | Cadmium | |
| [Selenium] | reddish | [Palladium] | } brownish black |
| [Tellurium] | black | [Rhodium] | |
| [Molybdenum] | brown | [Osmium] | |

TABLE I.—CONTINUED.

| BODIES PRECIPITATED BY HYDROSULPHURET OF AMMONIA. | | |
|--|---|---|
| <i>As sulphurets :</i> | <i>As oxides :</i> | <i>As salts :</i> |
| Nickel } Cobalt } Manganese Iron Zinc [Uranium] | Alumina [Glucina] Sesquioxide of Chromium { [Thorina] [Yttria] [Oxide of Cerium] [Zirconia] [Titanic acid] [Tantalic acid] | Baryta Strontia Lime { in combination with phosphoric acid, oxalic acid, boracic acid, hydrofluoric acid Magnesia { in combination with phospho- ric acid |

TABLE II.

BEHAVIOUR OF THE MORE IMPORTANT ACIDS ON HEATING THEIR SALTS WITH SULPHURIC ACID.

WITHOUT DECOMPOSITION.

Carbonic acid. Indorous; precipitates lime-water.

Sulphurous acid. Odour of burning sulphur; is decomposed by sulphuretted hydrogen with separation of sulphur.

Hydrosulphuric acid, (Sulphuretted hydrogen.) Odour of rotten eggs; black precipitate with lead salts.

Muriatic acid. Acid vapour fuming in contact with air.

Hydrofluoric acid. Etches glass.

Nitric acid. Colourless acid gas; in presence of copper turnings red vapours.

WITH DECOMPOSITION.

Hydriodic acid. Violet vapours of iodine.

Hydrobromic acid. Brown vapours of bromine.

Hydrocyanic acid. Disengagement of carbonic oxide, which burns with a blue flame. With dilute sulphuric acid hydrocyanic acid is evolved. Compounds of *ferrocyanogen* and *ferricyanogen* exhibit similar reactions.

Chloric acid. Dark yellow gas.

Hypochlorous acid. Yellowish green gas, chlorine.

Bromic acid. Brown vapours of bromine and oxygen.

Chromic acid. Evolution of oxygen.

Formic acid. Evolution of pure carbonic oxide.

Acetic acid. Evolution of acetic acid; in presence of alcohol of acetic ether.

Oxalic acid. Decomposed into carbonic acid and carbonic oxide without separation of charcoal.

Tartaric acid, Citric acid, and Malic acid. Decomposed with separation of charcoal; carbonic acid, carbonic oxide, and sulphurous acid being disengaged.

TABLE III.

BEHAVIOUR OF THE MORE IMPORTANT ACIDS WITH
CHLORIDE OF BARIUM.

CHLORIDE OF BARIUM precipitates :

a. From neutral solutions, the precipitate being soluble
in muriatic or nitric acid.

| | | | | | |
|--------------------------|---|--------|------------------------|---|---------|
| <i>Sulphurous acid</i> | } | white. | <i>Boracic acid</i> | } | white. |
| <i>Carbonic acid</i> | | | <i>Tartaric acid</i> | | |
| <i>Phosphoric acid</i> | | | <i>Citric acid</i> | | |
| <i>Silicic acid.</i> | | | <i>Arsenic acid</i> | | |
| <i>Hydrofluoric acid</i> | | | <i>Arsenious acid*</i> | | |
| <i>Oxalic acid</i> | | | <i>Chromic acid</i> | | yellow. |

b. From neutral and acid solutions, the precipitate
being insoluble in muriatic and nitric acid.

| | | |
|-------------------------|---|--------|
| <i>Sulphuric acid</i> | } | white. |
| [<i>Selenic acid</i>] | | |

Seleniate of baryta disengages chlorine, when boiled
with muriatic acid, selenious acid being formed.

* *Boracic, Tartaric, Citric, Arsenic and Arsenious acids*, are
not precipitated in the presence of ammoniacal salts.

TABLE IV.

BEHAVIOUR OF THE MORE IMPORTANT ACIDS WITH
NITRATE OF SILVER.

NITRATE OF SILVER precipitates :

a. From neutral solutions, the precipitate being soluble in nitric acid.

| | | | | |
|------------------------|---|---|---|-----------------|
| <i>Phosphoric acid</i> | . | . | . | yellow or white |
| <i>Boracic acid</i> | . | . | . | white |
| <i>Silicic acid</i> | . | . | . | white |
| <i>Chromic acid</i> | . | . | . | red |
| <i>Oxalic acid</i> | . | . | . | white |
| <i>Tartaric acid</i> | . | . | . | white |
| <i>Citric acid</i> | . | . | . | white |
| <i>Arsenic acid</i> | . | . | . | brown |
| <i>Arsenious acid</i> | . | . | . | yellow |

b. From neutral and acid solutions, the precipitate being insoluble in nitric acid.

Iodic acid, the original salt detonates with ignited charcoal.

Muriatic acid, white precipitate soluble in ammonia.

Hydrobromic acid, precipitate difficultly soluble in ammonia.

Hydriodic acid, yellow precipitate, nearly insoluble in ammonia.

Hydrocyanic acid, white precipitate, which decomposes when heated, and disengages hydrocyanic acid when moistened with muriatic acid.

Hydrosulphocyanic acid, white curdy precipitate difficultly soluble in ammonia.

Hydrosulphuric acid, (*Sulphuretted hydrogen*), black precipitate.

Sulphurous acid
Formic acid } On heating, reduce nitrate of silver.

TABLE V.

BEHAVIOUR OF CERTAIN ACIDS, WITH CHLORIDE OF CALCIUM.

CHLORIDE OF CALCIUM precipitates :

From neutral solutions ; also in the presence of ammoniacal salts or free ammonia.

Sulphuric acid, from solutions not too dilute ; completely by addition of alcohol.

Phosphoric acid, white precipitate, soluble in acetic acid, when freshly thrown down.

Hydrofluoric acid, white precipitate, insoluble in acetic acid, and partly soluble in muriatic acid.

Oxalic acid, white precipitate, insoluble in acetic acid.

Tartaric acid, white precipitate, soluble in cold potassa, and re-precipitated by boiling.

Citric acid, the precipitate is produced only by boiling, and insoluble in potassa.

Chloric acid and *Nitric acid*, are not precipitated by any reagent. The salts of these acids deflagrate on ignited charcoal.

INDEX.

A.

| | |
|----------------------------|---------------|
| Acacia | 93 |
| Acacia arabica | 93 |
| Catechu | 61 |
| gummifera | 93 |
| Senegal | 93 |
| vera | 93 |
| Acer saccharinum | 230 |
| Acetic acid | 12 |
| Acid, acetic | 12, 293 |
| arsenious | 39, 271 |
| benzoic | 46 |
| boracic | 51 |
| carbonic | 58 |
| citric | 66 |
| hydrochloric | 143, 291 |
| hydrocyanic | 95 |
| muriatic, | 143, 271, 291 |
| nitric, | 148, 292 |
| nitromuriatic | 150, 292 |
| oxalic | 158, 304 |
| phosphoric | 162 |
| prussic | 96 |
| succinic | 225 |
| sulphuric | 233, 295 |
| sulphurous | 311 |
| tartaric | 241, 305 |
| titanic | 251 |
| Acidimeter | 170 |
| Acidum, aceticum | 12 |
| arseniosum | 39 |
| benzoicum | 46 |
| citricum | 66 |
| hydrocyanicum | 96 |
| muriaticum | 143 |

| | |
|-------------------------------------|---------|
| Acidum, nitricum | 148 |
| nitromuriaticum | 150 |
| phosphoricum dilu- tum | 162 |
| sulphuricum | 233 |
| tartaricum | 241 |
| Aconitia | 18 |
| Aconitine | 18 |
| Aconitum | 18 |
| Aconitum Napellus | 18 |
| Adeps | 94 |
| Æther nitrosus | 150 |
| sulphuricus | 237 |
| Alcohol | 19, 291 |
| Alcoometer, centesimal | 19 |
| Alkalimeter | 169 |
| Aloe | 23 |
| arborescens | 23 |
| socotrina | 23 |
| spicata | 23 |
| vulgaris | 23 |
| Aloes | 23 |
| barbadoes | 24 |
| caballine | 24 |
| Cape | 23 |
| Socotrine | 23 |
| Alpinia Cardamomum | 58 |
| Alum | 24 |
| ammonia | 24 |
| soda | 24 |
| Alumen | 24 |
| Amber | 25 |
| Ammonia | 25, 299 |
| acetate of (solution) | 26 |
| carbonate of | 299 |
| hydrosulphuret of | 296 |

| | |
|------------------------------|----------|
| Bryonia dioica | 75, 108 |
| epigæa | 75 |
| Burgundy pitch | 52 |
| Burnt alum | 24 |
| Buxus sempervirens | 165, 252 |

C.

| | | | |
|-----------------------------------|---------|--------------------------------|---------|
| Caballine Aloes | 24 | Cassius, purple of | 184 |
| Cacao | 53 | Castor | 60 |
| Cajeputi | 55 | Castoreum | 60 |
| Cajeput oil | 55 | Castor fiber | 60 |
| Calamine | 268 | Castor oil | 60 |
| Calamus Draco | 86 | Catechu | 61 |
| Calcii chloridum | 55 | Cayenne pepper | 62 |
| Calcium, chloride of | 55, 301 | Cephælis Ipecacuanha | 100 |
| Calendula officinalis | 194 | Cera alba | 255 |
| Calomel | 133 | Cera flava | 255 |
| Calx | 115 | Cerusse | 111 |
| Calx chlorinata | 50 | Cetaceum | 219 |
| Camphor | 56 | Charcoal | 62, 312 |
| Camphora | 56 | animal | 63 |
| Canella | 56 | Chicory | 72 |
| Canella alba | 56 | Chicory coffee | 72 |
| Cane sugar | 226 | Chlorine | 311 |
| Canna coccinea | 57 | Chocolate | 53 |
| Canna starch | 57 | Chrome yellow | 112 |
| Cantharis vesicatoria | 57 | Cider | 64 |
| Cantharides | 57 | Cider vinegar | 13 |
| Cantharis | 57 | Cinchona | 160 |
| Cape aloes | 23 | calisaya | 160 |
| Capsicum | 62 | cordifolia | 185 |
| annuum | 62 | corona | 160 |
| baccatum | 62 | rubra | 160 |
| Caraway seeds | 58 | Cinchonine | 187 |
| Carbo animalis | 63 | Cinnabar | 136 |
| ligni | 62 | Cinnamomum | 65 |
| Carbonic acid water | 58 | Cinnamon | 65 |
| Cardamomum | 58 | oil of | 66 |
| Cardamon seed | 58 | Citric acid | 66 |
| Caribbean bark | 161 | Citrus medica | 66 |
| Carmine | 59 | Cloves | 68 |
| Carthamus | 192 | Coal gas | 68 |
| tinctorius | 192 | Cobalt | 39, 69 |
| Carum | 58 | Cobalt blue | 248 |
| carui | 58 | oxide of | 69 |
| Caryophyllus | 68 | Cocci | 70 |
| Caryophyllus aromaticus | 68 | Cocculus Indicus | 69 |
| Cassia | 66 | palmatus | 75 |
| acutifolia | 201 | suberosus | 69 |
| Æthiopica | 201 | cacti | 70 |
| elongata | 201 | Cochineal | 70 |
| obovata | 201 | Cocos nucifera | 159 |
| | | oleracea | 159 |
| | | Codeine | 157 |
| | | Coffee | 71 |
| | | Colchicine | 73 |
| | | Colchici radix | 73 |
| | | Colchicum | 73 |
| | | autumnale | 73, 253 |
| | | Colcothar | 74, 105 |

| | | | |
|----------------------------------|---------|--------------------------------------|----------|
| Colocynth | 74 | Curcuma longa | 251 |
| Colocynthis | 74 | Curcumin | 251 |
| Colomba | 75 | Curry powder | 251 |
| Colomba root | 75 | Cutch | 61 |
| Colutea arborescens | 202 | Cynanchum Monspeliacum | 198 |
| Common Salt | 76 | oleæfolium | 201 |
| Coneine | 80 | | |
| Confectionary | 78 | D. | |
| Conia | 80 | Decantation | 283 |
| Conii folia | 80 | Diplolepis gallæ tinctoriæ | 87 |
| Conium | 80 | Distillation | 285 |
| Conium maculatum | 80 | Distilled vinegar | 12 |
| Convulvulus Scammonia | 198 | Distilled waters | 154 |
| Copaiba | 41 | Dorema Armeniacum | 28 |
| Copaifera | 41 | Dracæna Draco | 86 |
| Copaifera Jaquini | 42 | Dragon's blood | 86 |
| Langsdorfii | 41 | Dropping bottle | 284 |
| Copper | 81, 308 | Dryobalanops aromatica | 56 |
| acetate of | 81 | Dyer's saffron | 192 |
| ammoniacal sulphate of | 82 | | |
| arsenate of | 199 | E. | |
| diacetate of | 82 | East Indian arrow-root | 38 |
| subacetate of | 82 | Edulcoration | 284 |
| sulphate of | 83, 310 | Eläis guineensis | 159 |
| Copperas | 104 | Emetina | 101 |
| Coriaria myrtifolia | 202 | Emetine | 101 |
| Corrosive sublimate | 131 | Epsom salt | 124 |
| Cream of tartar | 167 | Ergot | 86 |
| Creamometers | 138 | Ergota | 86 |
| Creasote | 83 | Essences | 153 |
| Creta | 117 | Ethiops mineral | 130 |
| Creta preparata | 117 | Evaporation | 284 |
| Crocus | 193 | Exhilarating gas | 149 |
| Crocus martis | 105 | | |
| Crocus sativus | 193 | F. | |
| Croton oil | 84 | Ferri et Potassæ, tartaras | 107 |
| Croton Tiglium | 84 | Ferri ferrocyanuretum | 183 |
| Crucibles | 286 | iodidum | 104 |
| Crude antimony | 35 | oxidum nigrum | 102 |
| potash | 168 | subcarbonas | 102, 105 |
| sulphur | 231 | sulphas | 104 |
| Crystallization | 280 | Ferrum | 101 |
| Cubeba | 85 | sesquioxidum | 105 |
| Cubebin | 85 | Ferula assafoetida | 40 |
| Cubebs | 85 | Filters | 283 |
| Cubic nitre | 216 | Filtration | 283 |
| Cucumis Colocynthis | 74 | Flour, wheat | 256 |
| Cupri subacetatis | 82 | Flowers of benzoin | 46 |
| sulphas | 83 | Flowers of sulphur | 231 |
| Cuprum | 81 | | |
| ammoniatum | 82 | | |
| Curcuma | 251 | | |
| angustifolia | 38 | | |

| | |
|---------------------------|-----|
| Fly powder | 39 |
| Frasera Walteri | 75 |
| Fraxinus Ornus | 129 |

G.

| | |
|--|---------|
| Galactometers | 138 |
| Gallæ | 87 |
| Gall-nuts | 87 |
| Gamboge | 88 |
| Gambogia | 88 |
| Garancine | 120 |
| Gentian | 89 |
| Gentiana | 89 |
| lutea | 89 |
| Gentianine | 89 |
| Gin | 19 |
| Glass of antimony | 32 |
| Glauber's salt | 217 |
| Glucose | 227 |
| Glycyrrhiza | 118 |
| echinata | 118 |
| glabra | 118 |
| lepidota | 118 |
| Glycyrrhizin | 118 |
| Gold | 89 |
| chloride of | 91, 306 |
| iodide of | 91 |
| Golden sulphuret of antimony | 34 |
| Granati radix | 165 |
| Grape sugar | 227 |
| Graphite | 91 |
| Green vitriol | 104 |
| Guaiac | 92 |
| Guaiaci lignum | 92 |
| resina | 92 |
| Guaiacum officinale | 92 |
| Gum Arabic | 93 |
| Gunpowder | 94 |

H.

| | |
|------------------------------------|-----|
| Hebradendron Gambogiodes | 88 |
| Hemlock | 80 |
| Hæmatoxylon | 119 |
| Campeachianum | 119 |
| Hog's lard | 94 |
| Homburg's sedative salt | 51 |
| Honey | 95 |
| Hops | 96 |
| Humulus | 96 |
| Humulus Lupulus | 96 |

| | |
|--|-----|
| Hydrargyri chloridum corrosi- vum | 131 |
| chloridum mite | 133 |
| cyanuretum | 130 |
| iodidum rubrum | 131 |
| oxidum nigrum | 135 |
| oxidum rubrum | 132 |
| sulphuretum ni- grum | 130 |
| sulphuretum ru- brum | 136 |
| Hydrargyrum | 129 |
| ammoniatum | 137 |
| Hydrochloric acid | 143 |
| Hydrocyanic acid | 96 |
| Hymenæa Courbaril | 29 |
| martiana | 29 |
| Hyoscyamia | 98 |
| Hyoscyamine | 98 |
| Hyoscyamus niger | 98 |
| Hypochlorite of lime | 50 |
| Hyponitrous ether | 150 |

I.

| | |
|-----------------------------------|----------|
| Ignition | 286 |
| India ink | 109 |
| India myrrh | 147 |
| Indigofera | 98 |
| Indigofera Anil | 98 |
| argentea | 98 |
| tinctoria | 98 |
| Indigo | 98 |
| solution of | 311 |
| Iodine | 99, 271 |
| tincture of | 100, 312 |
| Iodinum | 99 |
| Ipecacuanha | 100 |
| lozenges | 101 |
| Ipomæa purga | 107 |
| Iron | 101, 303 |
| black oxide of | 102 |
| carbonate of | 102 |
| hydrated sesquioxide of | 106 |
| lactate of | 102 |
| perchloride of | 103 |
| protiodide of | 104 |
| protoxide of | 104 |
| protosulphate of | 309 |
| red oxide of | 105 |
| sesquichloride of | 103 |
| sesquioxide of | 105 |
| sulphate of | 104 |

| | |
|-------------------------------|-----|
| Iron and Potassa, tartrate of | 107 |
| Isatis tinctoria | 93 |
| Ivory black | 63 |

J.

| | |
|---------------------------|---------|
| Jalap | 107 |
| Jalapa | 107 |
| Jatropa Manihot | 3S, 240 |

K.

| | |
|--------------------------|-----|
| Kelp | 212 |
| Kermes mineral | 32 |
| King's yellow | 39 |
| Kino | 108 |

L.

| | |
|---|----------|
| Labarraque's disinfecting li- quid | 215 |
| Lac sulphuris | 233 |
| Lactometers | 138 |
| Lactoscopes | 138 |
| Lampblack | 109 |
| Lapis calaminaris | 268 |
| Lapis lazuli | 252 |
| Larix Europæa | 253 |
| Laurus Camphora | 56 |
| Cinnamomum | 65 |
| Lead | 109 |
| acetate of | 110, 310 |
| carbonate of | 111 |
| chromate of | 112 |
| iodide of | 113 |
| protoxide of | 114 |
| red oxide of | 115 |
| Lead powder | 250 |
| Lemon juice | 115 |
| Lime | 115 |
| carbonate of | 117 |
| caustic | 309 |
| chloride of | 50 |
| hypochlorite of | 50, 118 |
| sulphate of | 309 |
| Lime water | 117 |
| Liquor ammoniæ acetatis | 26 |
| Liquorice | 118 |
| Litharge | 114 |
| Litmus | 294 |
| Liver of antimony | 32 |
| Logwood | 119 |
| Lolium temulentum | 46 |
| Lupulin | 96 |

| | |
|----------------------|-----|
| Lycopodium | 119 |
| clavatum | 119 |

M.

| | |
|----------------------------------|----------|
| Mace | 152 |
| oil of | 153 |
| Madder | 120 |
| Magnesia | 121 |
| calcined | 121 |
| carbonate of | 122 |
| heavy calcined | 122 |
| Henry's calcined | 122 |
| sulphate of | 124 |
| Magnesiæ carbonas | 122 |
| sulphas | 124 |
| Manganese, peroxide of | 126 |
| Manganisii binoxidum | 126 |
| Manna | 128 |
| flake | 129 |
| Mannite | 129 |
| Maple sugar | 230 |
| Maranta | 37 |
| Maranta arundinacea | 37 |
| Marmor | 117 |
| Martial Ethiops | 102 |
| Meadow saffron | 73 |
| Mel | 95 |
| Melaleuca Leucadendron | 55 |
| Menispermum Cocculus | 69 |
| palmatum | 75 |
| Menstruum | 280 |
| Mercury | 129 |
| bicyanide of | 130 |
| black sulphuret of | 130 |
| cyanuret of | 130 |
| perchloride of | 131 |
| periodide of | 131 |
| peroxide of | 132 |
| protochloride of | 133 |
| protoxide of | 135 |
| red oxide of | 132, 135 |
| red sulphuret of | 136 |
| white precipitate of | 137 |
| Metroxylon Sagus | 194 |
| Milk | 138 |
| Minium | 115 |
| Mocha coffee | 72 |
| Monkshood | 18 |
| Morphia | 141 |
| Morphiæ hydrochloras | 142 |
| sulphas | 142 |

| | |
|-------------------------|----------|
| Morphine | 141, 157 |
| acetate of | 141 |
| muriate of | 142 |
| sulphate of | 142 |
| Moschus | 145 |
| moschiferus | 145 |
| Mother water | 281 |
| Muriatic acid | 143, 271 |
| Mushrooms | 144 |
| Musk | 145 |
| Mustard | 146 |
| Myristica | 152 |
| moschata | 152 |
| tomentosa | 152 |
| Myroxylon | 43 |
| Peruiferum | 43 |
| Toluifera | 43 |
| Myrrh | 147 |
| Myrrha | 147 |

N.

| | |
|----------------------------------|----------|
| Naphtha | 148 |
| Narcotine | 157 |
| Nerium tinctorium | 98 |
| Neutralization | 280 |
| Nitre | 172 |
| cubic | 216 |
| Nitric acid | 148 |
| Nitrogen, protoxide of | 149 |
| Nitromuriatic acid | 150 |
| Nitrous ether | 150 |
| Nutmeg | 152 |
| butter of | 153 |
| Nux vomica | 153, 225 |

O.

| | |
|----------------------------|----------|
| Oil, cod | 272 |
| linseed | 272 |
| olive | 155, 272 |
| of cinnamon | 66 |
| of poppies | 272 |
| of sweet almonds | 272 |
| of vitriol | 233 |
| tallow | 272 |
| whale | 272 |
| Oils, essential | 153 |
| fat or fixed | 153, 272 |
| volatile | 153 |
| Olea Europæa | 155 |
| Oleine | 272 |

| | |
|-----------------------------|----------|
| Oleometer | 273 |
| Oleum olivæ | 155 |
| ricini | 60 |
| rosæ | 192 |
| Olive oil | 155 |
| Opium | 157, 273 |
| Smyrna | 157 |
| Turkey | 157 |
| Orchis mascula | 195 |
| Ornus Europæa | 129 |
| Orpiment | 39 |
| Oxalic acid | 153 |
| Oxalis Acetosella | 158 |

P.

| | |
|----------------------------------|-----|
| Palm oil | 159 |
| Papaver somniferum | 157 |
| Pearl sago | 195 |
| Pearl white | 49 |
| Pepper, black | 159 |
| white | 159 |
| Peruvian bark | 160 |
| Pewter filings | 250 |
| Phosphoric acid | 162 |
| Phosphorus | 163 |
| Phloridzin | 162 |
| Phlorizin | 162 |
| Physeter macrocephalus | 219 |
| Picræna excelsa | 185 |
| Picrotoxine | 70 |
| Pimpinella anisum | 30 |
| Pinus Abies | 52 |
| Picea | 52 |
| Piper Cubeba | 85 |
| nigrum | 159 |
| Piperine | 160 |
| Pitaya bark | 161 |
| Piton bark | 161 |
| Pix abietis | 52 |
| Platinum, chloride of | 307 |
| Plumbago | 91 |
| Plumbi acetas | 110 |
| carbonas | 111 |
| iodidum | 113 |
| oxidum rubrum | 115 |
| oxidum semivitreum | 114 |
| Polygonum tinctorium | 98 |
| Pomegranate bark | 163 |
| Poppy oil | 155 |
| Portland arrow-root | 33 |
| Potash | 168 |

| | |
|-------------------------|-----|
| Rubia peregrina | 120 |
| tinctorum | 120 |
| Rum | 19 |
| Rumex Acetosa | 158 |

S.

| | |
|-------------------------|----------|
| Saccharum | 226 |
| officinarum | 226 |
| Safflower | 192 |
| Saffron | 193 |
| of antimony | 32 |
| Sago | 194 |
| meal | 195 |
| Sigus Rumphii | 194 |
| Sal ammoniac | 26, 293 |
| Salep | 195 |
| Salicin | 196 |
| Salix alba | 196 |
| Salt of sorrel | 166 |
| Salt of tartar | 170 |
| Saltpetre | 172 |
| Sandal wood | 188 |
| Santalin | 188 |
| Santalum | 188 |
| Sarsaparilla | 196 |
| false | 197 |
| Saturation | 280 |
| Scammonium | 198 |
| Scammony | 198 |
| Scheele's green | 199 |
| Schweinfurt green . . . | 200 |
| Sealing wax | 200 |
| Selenium | 200 |
| Senna | 201 |
| Silver | 203 |
| ammonio-nitrate of . | 310 |
| chloride of | 204 |
| cyanide of | 205 |
| nitrate of | 205, 302 |
| Sinapis | 146 |
| Sinapis alba | 146 |
| nigra | 146 |
| Smalt | 69 |
| Smelling salts | 27 |
| Smilax medica | 196 |
| officinalis | 196 |
| Sarsaparilla | 196 |
| syphilitica | 196 |
| Smyrna opium | 157 |
| Soap | 207 |
| officinal | 210 |
| soft | 208 |

| | |
|-----------------------------|----------|
| Soap, tincture of | 203 |
| yellow or rosin . . . | 209 |
| Soda, acetate of | 210 |
| biborate of | 211 |
| bicarbonate of | 212 |
| carbonate of | 212, 214 |
| caustic | 219 |
| chloride of | 215 |
| hydrate of | 219 |
| hypochlorite of . . . | 215 |
| hyposulphite of . . . | 215 |
| nitrate of | 216 |
| phosphate of | 216, 303 |
| sulphate of | 217 |
| Soda alum | 24 |
| Soda ash | 170, 212 |
| Soda water | 218 |
| Sodæ acetas | 210 |
| bicarbonas | 212 |
| boras | 211 |
| carbonas | 214 |
| carbonas impura . . . | 212 |
| chlorinatæ liquor . . | 215 |
| phosphas | 216 |
| sulphas | 217 |
| Sodium, iodide of | 219 |
| protoxide of | 219 |
| Solids, reduction to powder | 279 |
| Soluble tartar | 175 |
| Solution | 279 |
| Solvent | 280 |
| Spanish fly | 57 |
| Specific gravity bottle . . | 20 |
| Spelter | 266 |
| Spermaceti | 219 |
| Spiritus ætheris nitrici . | 151 |
| Spiritus ætheris sulphurici | 238 |
| Spurred rye | 86 |
| Stannum | 248 |
| Starch | 220 |
| common | 221 |
| potatoe | 221 |
| Starch paste | 312 |
| Starch sugar | 227 |
| Storax | 222 |
| common | 223 |
| liquid | 223 |
| Strontium, chloride of . . | 223 |
| Strychnia | 224 |
| Strychnine | 224 |
| Strychnos nux vomica . . | 224 |
| Styrax | 222 |
| Styrax Benzoin | 46 |

| | |
|---------------------------------|----------|
| Styrax officinale | 222 |
| Sublimation | 285 |
| Sublimed sulphur | 231, 232 |
| Succinic acid | 225 |
| Succinum | 23 |
| Sugar | 226 |
| cane | 226 |
| maple | 230 |
| purified | 226 |
| starch | 227 |
| unpurified | 226 |
| white | 226 |
| Sugar of grapes | 227 |
| Sugar of lead | 110 |
| Sulphur | 231 |
| iodide of | 233 |
| milk of | 233 |
| præcipitatum | 233 |
| precipitated | 233 |
| vegetable | 120 |
| Sulphuretted hydrogen | 295 |
| Sulphuric acid | 233 |
| Sulphuric ether | 237 |
| spirit of | 238 |
| Sulphuris iodium | 233 |
| Sweet spirit of nitre | 151 |

T.

| | |
|---------------------------------|--------|
| Tallow | 238 |
| Tamarinds | 239 |
| Tamarindus | 239 |
| Indica | 239 |
| orientalis | 239 |
| Tapioca | 240 |
| pearl | 240 |
| Tartar emetic | 34, 35 |
| soluble | 175 |
| Tartaric acid, | 241 |
| Tea | 242 |
| Terra Japonica | 61 |
| Tephrosia Apolinea | 201 |
| Testing | 286 |
| Tests, definition of | 287 |
| preparation of | 287 |
| Thea Bohea | 242 |
| chinensis | 242 |
| viridis | 242 |
| Thein | 242 |
| Thenard's blue | 248 |
| Theobroma cacao | 53 |
| Thousand grain bottle | 20 |
| Tigllii oleum | 84 |

| | |
|------------------------------|----------|
| Tin | 248 |
| bisulphuret of | 250 |
| powder of | 249 |
| protochloride of | 306 |
| Tin filings | 249 |
| Tinctura iodini | 100 |
| Tincture of chloride of iron | 103 |
| Titanic acid | 251 |
| Tous les mois | 57, 221 |
| Triticum vulgare | 256 |
| Turmeric | 251, 294 |
| Turnbull's blue | 184 |
| Turpentine, Venice | 253 |
| Tutty | 270 |

U.

| | |
|----------------------------|-----|
| Ultramarine | 252 |
| Uncaria catechu | 61 |
| Gambir | 61 |
| Uvaria Ceylanica | 85 |
| Uva-ursi | 252 |

V.

| | |
|-----------------------------------|-----|
| Vaccinium Vitis-idæa | 252 |
| Venice turpentine | 253 |
| Veratria | 253 |
| Veratrine | 253 |
| Veratrum album | 253 |
| Sabadilla | 253 |
| Verdigris, crystallized | 81 |
| common | 82 |
| distilled | 81 |
| Verjuice | 16 |
| Vermilion | 136 |
| Vinegar | 13 |
| Vinum | 262 |
| Vitriol, blue | 83 |
| oil of | 295 |

W.

| | |
|------------------------|----------|
| Wad | 126 |
| Water | 254, 290 |
| distilled | 254 |
| Wax | 255 |
| Wheat flour | 256 |
| Whiskey | 19 |
| White lead | 111 |
| Wine | 262 |
| Wine vinegar | 13 |

| | | | |
|-----------------------------|----------|-----------------------------|----------|
| Winterana Canella | 56 | Zinc, chloride of | 268 |
| Wood vinegar | 13 | flowers of | 266, 269 |
| Z. | | oxide of | 269 |
| Zaffre | 69 | sulphate of | 270 |
| Zinc | 266, 308 | Zinci acetas | 267 |
| acetate of | 267 | carbonas | 268 |
| butter of | 268 | chloridum | 268 |
| carbonate of | 268 | oxidum | 269 |
| | | sulphas | 270 |
| | | Zincum | 265 |





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